A

JOURNAL

OF

NATURAL PHILOSOPHY, CHEMISTRY,

AND

THE ARTS.

DECEMBER, 1806.

ARTICLE I.

Facts and Observations respecting Vision under Water; and various Particulars relative to Swimming, &c. In a Letter from James Horsburgh, *Esq.*

To Mr. NICHOLSON.

Sir, Walworth, Nov. 6, 1806.

THE perusal of your observations relative to Swimming, in No. 58 of your Journal, and the letters from your correspondent inserted in Nos. 60 and 61, affirming that objects are visible to the human eye under water, which concurs not with your opinion, encourage me to state some few facts relative to this subject, the result of my own observations. On swimming, and vision under water.

In high latitudes the sea is seldom transparent; but within the tropics, and near the equator, the bottom is often visible in from ten to fifteen or twenty fathoms water, when it consists of variegated coral or white sand and coral mixed. In various parts of the Indian seas, Great transparency of the sea between tropics. Bottom seen at 150 feet depth.

the bottom is discernible at the depths mentioned above. In the Mindora Sea I have seen the spotted coral at the bottom when the depth of water over it was twenty-five fathoms; and have often tacked ship on the edges of coral shoals, by the appearance of the bottom, in depths of ten and twelve fathoms.

The author can see objects with the face under water nearly as well as in the air.

Swimming has ever been my favourite amusement. At Madras, where the surf is high, and ships' boats not permitted to land, I once had the imprudence to swim on shore through the surf, by way of diversion, and returned through it to a boat at a grapnel outside, which nearly cost me my life, being obliged to dive so frequently in resisting many heavy surfs. I have always observed when the bottom was clear, and any object upon it visible when my head was above water, it was nearly as well perceived when my head was under water. At the island Diego Garcia, where the water is very transparent in the harbour and at other places, I have frequently, when swimming under water, seen fishes darting about in various directions, and every article on the bottom very plain. The legs and feet of persons standing at six or eight yards distance were always visible in clear water when my head was under it; and at discretion easily taken hold of, by swimming under water to them with open eyes.

As far as his experience goes, all persons can see under water

I have always supposed that all persons could see under water, if timidity did not prevent them from opening their eyes during immersion; but must own that I have been in company with persons who could swim, but could not be prevailed on to open their eyes under water, affirming that they could not, although they endeavoured to do it. Those persons who could open their eyes with facility whilst immersed, always asserted that they saw objects in the water. Vision under water is probably confined to this element, for I never could distinguish external objects, such as the sun, clouds, &c. but only confused rays of light (in looking upward) were visible.

— but not objects in the air, while themselves are immersed.

Infants probably will float.

It is probable that most infants will float; I have seen one of ten or twelve months old fall from a boat into the water; the mother leaped in and rescued it, apparently without either receiving injury. The natives of China

that

that live in boats do not, however, trust to their children floating naturally, for they keep gourds fixed to their shoulders to prevent them sinking should they happen to fall in the water. This precaution seems prudent in China, the water in the canals and rivers here being of a very soft quality.

Men who cannot swim, happening to fall in the water, are certainly (as you observe) very apt to drown themselves by pushing their hands and arms above water; for a person cannot sink if the hands are kept under the surface and a gentle motion performed by them. But I cannot avoid observing that Doctor Franklin's remarks relative to the specific gravity of the human body in salt and fresh water seem liable to some objections, if indiscriminately applied to all persons, there being great reason to think the specific gravity of the human species differs considerably. The following instance appears to favour this opinion: In company with two friends, some years ago, it was customary for us to proceed to the sea to enjoy the exercise of swimming; this was at Bombay in India; the gentlemen who accompanied me could both swim, but neither of them had ever tried to float on the water without motion. When swimming on their backs they were requested to endeavour to lie quiet without any motion of hands or feet. The best swimmer of the two could not float without using a little motion with his hands or feet, although he repeated the trial several days; when he lay without motion his head gradually sunk till completely under water. This person was of short stature, strong, and athletic. The other gentleman was of a spare make, thin, and delicate in constitution; and at the first trial floated on the surface like a cork, without any motion of hands or feet; his toes, part of his feet, knees, part of his shoulders and head, remained above the surface, when every part of his body was at rest; whilst the stout gentleman could in no position float on the surface without a gentle motion of hands or feet. It certainly appeared to me evident that the specific gravity of these persons differed considerably.

Men are apt to drown themselves by raising their hands.

Facts which shew that the specific gravities of men, and consequently their powers of floating, are different.

When the sun has been obscured by clouds, or otherwise not too powerful, I have frequently amused myself

Particular observations respecting the

situation of floating persons, &c.

by lying on my back without motion for considerable periods of time; sometimes for half an hour, or longer, when the water was mild and smooth; at such times I have found a strong inclination to sleep, which induced me to lie no longer without motion, for fear of carrying this amusement too far. When floating on salt water I have always observed the following effects produced by placing the arms in various positions: 1st. When my arms were placed across my breast, the body floating in the horizontal position, face upwards, in a short time the feet and legs sunk downward, until the body assumed nearly a vertical position; then the head frequently sunk so far as to bring the nose under the surface, but the face quickly resumed its former position above the surface without using the least motion of any limb. The body alters its position, sometimes, by turning round from one side to the other when the feet sink far below the surface, but soon returns to its natural floating position with the back undermost, the legs and feet at the same time ascending to the surface as at first. With the hands laid across the breast this revolution of the body in floating on the sea has been reiterated often in the space of a quarter of an hour without moving a limb.

2nd. When the arms were laid close along each side, over the belly, or under the back, the body was liable to the same revolutions as mentioned above.

3rd. When the arms were stretched in a perpendicular direction from the body, they always prevented it from turning round by acting on the water as levers to retain the body in its natural floating position; although with the arms in this position the feet sometimes descended considerably from the surface, but shortly after ascended to it again.

4th. To keep the body in the horizontal equilibrium, the arms were stretched backward beyond the head, the hands open and resting on the surface of the water; the legs and feet then remained constantly near the surface, the toes generally above it. On drawing the arms from this position gradually forward to the perpendicular direction from the body, the feet always inclined to descend from the surface; but so soon as the arms were moved

moved more backward, the toes and part of the feet always appeared above water, the body continuing in perfect equilibrium, with the face and toes above the surface, the chest and knees close to it. When the water is not too cold, and the surface smooth, it would be an easy matter to fall asleep floating in this position. Particular observations respecting the situation of floating persons, &c.

None but those who can swim above and under water will readily comprehend the great pressure of the water upward, and how easily it will sopport on its surface human beings, when it is smooth, without any broken water. For amusement I have gone into the sea full dressed into deep water, and by floating in various ways, as most convenient, taken off coat, waistcoat, opened the knee buttons of my smallclothes, taken them and stockings off with equal ease as on shore, and finally pulled my shirt off, swimming then with them to the shore.

Swimming is very easily acquired when a few good lessons are given. Seamen, and others who are liable to be much on the sea, rivers, canals, &c. should not neglect to learn this art.

I am, Sir,
Your most obedient,
and most humble servant,
JAS. HORSBURGH.

II.

On the Quantity and Velocity of the Solar Motion. By WILLIAM HERSCHEL, *L.L.D. F.R.S. From the Philosophical Transactions for* 1806.

[Concluded from p. 242.]

Remarks on the sidereal Motions as they are represented from Observation.

AS we have now before us a set of figures which give a complete view of the result of the calculations contained in the Xth Table, we may examine the arrangements of the stars, and draw a few conclusions from them, that will Investigation of the proper motion of the sun.

Investigation of the proper motion of the sun.

will throw some light upon the subject of our present inquiry.

In the first place, then, we have to observe in Fig. 1, that 17 out of the 21 stars, whose motions are directed towards the north, are crowded together into a compass of little more than 76½ degrees. But this figure, as we have shown, is drawn from observation. We are consequently obliged to conclude, that, if these motions are the real ones, there must be some physical cause which gives a bias to the directions in which the stars are moving; if so, it would not be improbable that the sun, being situated among this group of stars, should partake of a motion towards the same part of the heavens.

Our next remark concerns the velocity of the sidereal motions; and therefore we must have recourse to Fig. 2, where we perceive that the greatest motions are not confined to the brightest stars. For instance, the velocity of β Virginis is but little inferior to that of Arcturus, and exceeds the velocity of Procyon. Likewise the velocities of β Aquilæ, α Libræ, and α Capricorni, surpass that of Sirius; and an inspection of the rest of the figure will be sufficient to show how very far the velocities of Capella, Lyra, Rigel, α Orionis, Aldebaran, and Spica, are exceeded by those of many other stars.

If we look at the arrangement of the stars with respect to the direction of the solar motion, we find in Fig. 3, that a somewhat different scattering of them has taken place; but still most of the stars appear to be affected by some cause which tends to lead them to the same part of the heavens, toward which the sun is moving; and the directions of the greatest number of them are not very distant from the line of the solar motion.

The whole appearance of this figure presents us with the idea of a great compression above the centre, arising from some general cause, and a still greater expansion in the lower part of it. The considerable projection of a few stars on both sides, is however a plain indication that the compressing or dilating cause does not act in their directions.

When the velocity of the stars, represented in the same point of view in Fig. 4, is examined, we find a particularity

ticularity in the direction and comparative velocities in the largest stars that must not be overlooked. Four of them, Rigel, α Orionis, Spica, and Antares, have a motion toward that part of the heavens in which the solar apex is placed, and their motions are very slow. Three other stars of the 1st magnitude, Arcturus, Procyon, and Sirius, move toward the opposite part of the heavens, and their motions, on the contrary, are very quick. Investigation of the proper motion of the sun.

The direction of the motion of Aldebaran, compared with its small velocity, is no less remarkable; and seems to be contrary to what has been pointed out with the three last mentioned stars; we shall however soon have an opportunity of showing that it is perfectly consistent with the principles of the solar motion.

The Solar Motion and its Direction assigned in the first Part of this Paper are confirmed by the Phenomena attending the observed Motions of the 36 *Stars.*

An application of some of the foregoing remarks will be our next subject; and I believe it will be found, that in the first place they point out the expediency of a solar motion. That next to this they also direct us to the situation of the apex of this motion: and lastly, that they will assist us in finding out the quantity requisite for giving us the most satisfactory explanation of the phenomena of the observed proper motions of the stars.

In examining the second figure, it has been shown that no less than six stars of the first magnitude, namely, Capella, Lyra, Rigel, α Orionis, Aldebaran, and Spica, have less velocity than nine or ten much smaller stars. Aldebaran and α Orionis indeed have so little motion that there are but three stars in all the 36 that have less. But the situation of these bright stars, from their nearness, must be favourable to our perceiving their real motions if they had any, unless they were counteracted by some general cause that might render them less conspicuous. Now to suppose that the largest stars should really have the smallest motions, is too singular an opinion to be maintained; it follows, therefore, that the apparently small motions of these large stars is owing to some general

Investigation of the proper motion of the sun.

ral cause, which renders at least some part of their real motion invisible to us. But when a solar motion is introduced, the parallax arising from that cause will completely account for the singularity of these slow motions.

If the foregoing argument proves the expediency of a solar motion, its direction is no less evidently pointed out by it. For if the parallax occasioned by the motion of the sun is to explain the appearances that have been remarked, it will follow, that a direction in opposition to the motion of Arcturus, will answer that end in the most satisfactory manner. That compression, for instance, which has been remarked in the motions of the stars moving toward the solar apex in Fig. 3, and which is so completely accounted for by a parallactic motion arising from the motion of the sun, points out the direction in which the sun should move, in order to produce this required parallactic motion. The expansion of the motions that are in opposition to the former is evidently owing to the same parallactic motions, which in this direction unite with the real motions of the stars; and as, in the former case, the observed motions are the differences between the parallactic and real motions, so here they are the sum of them.

The remark that stars having a side motion, are not affected by the cause of the compression or expansion, which acts upon the rest, is perfectly explained; for a parallactic motion, in the direction of the motion of Arcturus, can have no effect in lengthening or shortening the perpendicular distance to which a star may move in a side direction.

I have only to add, that the small velocities of Rigel, α Orionis, Spica, and Antares, in Fig. 4, as well as the great velocities of Arcturus, Procyon, and Sirius, point out the same apex which in the first part of this Paper has already been established by more extended computations.

The case of Aldebaran, though seemingly contrary to what has been shown, confirms the same conclusions. This will appear by considering that a star, moving toward the solar apex with a greater real motion than its parallactic one, must continue apparently to move in its real

real direction; but should a star, such as Aldebaran, move toward the apex with less velocity than the paralactic motion which opposes it, there will arise a change of direction, and the star will be seen moving toward the opposite part of the heavens. Investigation of the proper motion of the sun.

Trial of the Method to obtain the Quantity of the Solar Motion by its Rank among the sidereal Velocities.

According to the conditions that have been explained, a calculation may be made with a view of equalizing the velocities of the sun and the star α Orionis; and the result of it will show that the proposed equality will be obtained when the solar motion is 1″,266230. It will moreover be found that so small an increase of this motion as 0″,01 would give us 19 stars with less, and 17 with more velocity than that which the calculation assigns to the sun; this consequently fixes one of the limits to which the solar motion ought not to come up, if we intend it should hold a middle rank among the sidereal velocities.

On the other hand, by a similar calculation of the velocities of the star Pollux and the sun, it appears that a solar motion of 0″,967754 will make them equal; and that a diminution of this motion not exceeding 0″,01 would give us 19 stars moving at a greater rate than the sun, and only 17 falling short of its velocity. This consequently fixes the other limit to which the solar motion ought not to be depressed. And thus it appears by this method, that the quantity we are desirous of ascertaining, is confined within very narrow bounds, and that by fixing upon a mean of the two limits, we may have the rank of the solar motion true to less than 0″,15.

Calculations for investigating the Consequences arising from any proposed Quantity of Solar Motion, and for delineating them by proper Figures.

Before we can justly examine the real motions of stars which it will be necessary to admit in consequence of a given solar motion, it will be convenient to have them represented in two figures that we may see their arrange-

Investigation of the proper motion of the sun.

ment and extent; and as a calculation of the required particulars will oblige us to fix upon a certain quantity, we shall take the motion that has been ascertained to belong to the middle rank of the sidererl velocities for a pattern. The result of the necessary calculations is as follows;

Table XI.

Names.	Parallactic Motion.	Real Motion.	Parallactic Angle.		Velocity.
Sun.....	0″,00000	1″,116992	0°.00′.00″		1116992
Sirius	0,75697	0,395212	149.20. 6	*sf*	395212
Arcturus...	0,59847	1,488713	179.59.55,7	*sp*	1786455
Capella.....	0,88905	0,506123	22.29.12,5	*nf*	632654
Lyra.....	0,36349	0,498949	40.29.14	*nf*	648634
Rigel	0,55470	0,709381	4.36.52	*np*	957665
αOrionis....	0,71410	0,842559	1.38.38	*np*	1137455
Procyon....	0,74161	0,523428	156.32.21	*sp*	732799
Aldebaran ..	0,72736	0,608148	2.45.15	*nf*	851407
Pollux	0,78643	0,743971	50.12.11	*np*	1056439
Spica.....	0,74009	0,902004	7. 6.44	*np*	1298886
Antares	0,74110	1,000835	0.16.10,5	*np*	1461219
Altair.....	0,64544	1,071012	40.48. 4	*nf*	1574431
Regulus	0,75095	0,706833	17.43.53	*np*	1046113
βLeonis	0,68003	0,443842	54.10.14,5	*np*	665763
βTauri.	0,73063	0,633317	2. 5.15,5	*nf*	949976
Fomalhaut..	0,66693	0,383414	13.22. 5,5	*nf*	575121
αCygni.	0,46516	0,529503	0.18. 2,2	*np*	847204
Castor	0,55841	0,474647	11.30.32	*np*	949293
αOphiuchi ..	0,35202	0,290934	8.23.43	*nf*	581869
αCoronæ ...	0,23427	0,370580	37.21.17	*nf*	741160
αAquarii ...	0,55743	0,756754	4.38.19,5	*nf*	1513508
αAndromedæ	0,55389	0,464035	2.33.34	*nf*	928071
αSerpentis ..	0,38655	0,598458	6.38.54	*nf*	1196917
αPegasi	0,55567	0,734265	5.35.47,5	*nf*	1468530
αHydræ	0,46554	0,538281	17. 8.26	*np*	1238046
α^2 Libræ	0,43377	0,563892	15. 4.29	*np*	1353342
γPegasi.....	0,44540	0,618272	1.39.27	*nf*	1545679
αArietis	0,43893	0,342934	9.35.29,5	*nf*	857336
αCeti	0,33271	0,454165	11.26. 5,5	*np*	1271662
αHerculis...	0,21909	0,446795	5.56.38,5	*nf*	1340388
βVirginis ..	0,36039	0,967572	48.29. 2,5	*nf*	2902716
γAquilæ....	0,30898	0,502168	0.36.25	*nf*	1506503
α^2 Capricorni	0,31390	0,537285	19.51.52,5	*nf*	1880497
βAquilæ....	0,24370	0,226458	96.36.59,5	*sp*	905830
α Capricorni.	0,26151	0,519230	17. 4.54,5	*nf*	2180769
α Libræ	0,17347	0,349371	26.29.44,5	*np*	2096229

Investigation of the proper motion of the sun.

By the contents of this Table, Fig 5 is drawn with the lines contained in the third column and the angles of the fourth; the scale of it is that of the 5th and 3d figures; and it represents the directions and angular quantities of the real motions that are required to compound with the parallactic effects of the second column, so as to produce those annual proper motions which are established by observation.

Fig. 6 is drawn on the reduced scale of the 2d and 4th figures. The lines make the same angles with the direction of the solar motion as before, but their lengths are in the proportion of the velocities contained in the last column.

Remarks that lead to a necessary Examination of the Cause of the sidereal Motions.

The first particular that will strike us when we cast our eye on Fig. 5, is the uncommon arrangement of the stars. It seems to be a most unaccountable circumstance that their real motions should be as represented in that figure; indeed, if we except only ten of the stars, all the rest appear to be actuated by the same influence, and, like faithful companions of the sun, to join in directing their motions towards a similarly situated part of the heavens.

This singularity is too marked not to deserve an examination; for unless a cause for such peculiar directions can be shown to exist, I do not see how we can reconcile them with a certain equal distribution of situations, quantities, and motions, which our present investigation seems to demand. In order to penetrate as far as we can into this intricate subject, we shall take a general view of the causes of the motions of celestial bodies.

A motion of the stars may arise either from their mutual gravitation toward each other, or from an original projectile force impressed upon them. These two causes are known to act on all the bodies belonging to the solar system, and we may therefore reasonably admit them to exert their influence likewise on the stars. But it will not be sufficient to know a general cause for their motions,

tions, unless we can show that its influence will tend to make them go toward a certain part of the heavens rather than to any other. Let us examine how these causes are acting in the solar system.

Investigation of the proper motion of the sun.

The projectile motions of the planets, the asteroids, and the satellites, excepting those of the Georgium Sidus, are all decidedly in favour of a marked singularity of direction. We may add to them the comet of the year 1682, whose regular periodical return in 1759 has sufficiently proved its permanent connection with the solar system. Here then we have not less than 23 various bodies belonging to the solar system to show that this cause not only can, but in the only case of which we have a complete knowledge, actually does influence the celestial motions, so as to give them a very particular appropriate direction. Even the exception of the Georgian satellites may be brought in confirmation of the same peculiarity; for though they do not unite with the rest of the bodies of our system, they still conform among each other to establish the same tendency of a similar direction in their motion round the primary planet. And thus it is proved that the similar direction of the motion of a group of stars may be ascribed to their similar projectile motions without incurring the censure of improbability.

Let us however pursue the objection a little farther, and as we have shown that the celestial bodies of the solar system actually have these similar projectile motions, it may be required that we should also prove that the stars have them likewise; since the appearances in Fig. 5 may otherwise be looked upon as merely the consequence of the assumed solar motion. To this I answer, that setting aside the solar motion, and allowing the observations of astronomers on the proper motion of the stars to give us the real direction and angular quantity of these motions, even then the same similarity will equally remain to be accounted for. In my examination of Fig. 1 and 3, it has been shown that we ought to ascribe the similar directions of the sidereal motions to some physical cause, which probably exerts its influence also on the solar motion; therefore in reverting to those figures I may

Investigation of the proper motion of the sun.

I may be said to appeal to the actual state of the heavens, for a proof of what has been advanced, with respect to the similarity of the directions of projectile motions.

Having thus examined one cause of the sidereal motions, and shown that as far as we are acquainted with its mode of acting in the solar system, it is favourable to a similariy of direction; and that moreover, if we ascribe the motion of the stars to it, we have also good reason, from observation, to believe it to be in favour of the same similarity; we may in the next place proceed to consider the mutual gravitation of the stars toward each other. This is an acknowledged principle of motion, and the laws of its exertion being perfectly known, we shall in this inquiry meet with no difficulty relating to its direction, which is always toward the attracting body.

Considerations of the attractive Power required for a sufficient Velocity of the sidereal Motions.

As attraction is a power that acts at all distances, we ought to begin by examining whether the motions of our stars can be accounted for by the mutual gravitation of neighbouring stars toward each other, or by a periodical binal revolution of them about a common centre of gravity; or whether we ought not rather to have recourse to some very distant attractive centre. This may be decided by a calculation of the effects arising from the laws according to which the principle of attraction is known to act. For instance, let the sun and Sirius be two equal bodies placed in the most favourable situation to permit a mutual approach by attraction: that is, let them be without projectile motions, and removed from all other stars which might impede their progress toward each other, by opposite attractions. Then, by calculation, the space over which one of them would move in a year, were the matter of both collected in the other as an attractive centre, would be less than a five thousand millionth part of a second; supposing that motion to be seen by an eye at the distance of Sirius, and admitting the parallax of the whole orbit of the earth on this star to be one second.

This

This proves evidently that the mere attraction of neighbouring stars acting upon each other cannot be the cause of the sidereal motions that have been observed.

Investigation of the proper motion of the sun.

In the case of supposed periodical binal revolutions of stars about a common centre of gravity, where consequently projectile motions must be admitted, the united power of the connected stars, provided the mass of either of them did not greatly exceed that of the sun, would fall very short of the attraction required to give a sufficient velocity to their motions. The star Arcturus, for example, which happens to move, as is required, in an opposite direction to the proposed solar motion, were it connected with the sun, and had the proper degree of necessary projectile motion, could not describe an arch of 1″ of its orbit, about their common centre, in less than 102 years; and though the opposite motion of the sun, by a parallactic effect would double that quantity, it still would fall short of the change we observe in this star in the course of a single year.

Other considerations are still more against the admission of such partial connections: they would entirely oppose the similarity of the directions of the sidereal motions that have been proved to exist, and which we are now endeavouring to explain.

Let us then examine in what manner a distant centre of attraction may be the cause of the required motions. By admitting this centre to be at a great distance, we shall have its influence extended over a space that will take in a whole group of stars, and thus the similar directions of their motions will be accounted for. Their velocities also may be ascribed to the energy of the centre, which may be sufficiently great for all the purposes of the required motions. A circumstance, however, attends the directions of the motions to be explained, which shows that a distant centre of attraction alone will not be sufficient; for these motions, as we may see in Fig. 3, though pretty similar in their directions, still are diverging; whereas if they were solely caused by attraction, they would converge toward the attracting centre, and point out its situation. It is therefore evident that projectile motions must be combined with attraction, and that the motions

Investigation of the proper motion of the sun.

motions of the stars when regulated in this manner, are not unlike the disposition by which the bodies of the solar system are governed. If we pursue this arrangement, it will be proper to consider the condition, and probable existence of such a centre of attraction.

There are two ways in which a centre of attraction, so powerful as the present occasion would require, may be constructed: the most simple of them would be a single body of great magnitude; this may exist, though we should not be able to perceive it by any superiority of lustre; for notwithstanding it might have the usual starry brightness, the decrease of its light arising from its great distance would hardly be compensated by the size of its diameter; but to have recourse to an invisible centre, or at least to one that cannot be distinguished from a star, would be entirely hypothetical, and, as such, cannot be admitted in a discussion, the avowed object of which is to prove its existence.

The second way of the construction of a very powerful centre, may be joint attraction of a great number of stars united into one condensed group.

The actual existence of such groups of stars has already been proved by observations made with my large instruments; many of those objects, which were looked upon as nebulous patches, having been completely resolved into stars by my 40 and 20-feet telescopes. For instance, the nebula discovered by Dr. Halley in the year 1714, in which the discoverer, and other observers after him, have seen no star, I have ascertained to be a globular cluster, containing, by a rough calculation, probably not less than fourteen thousand stars. From the known laws of gravitation, we are assured that this cluster must have a very powerful attractive centre of gravity, which may be able to keep many far distant celestial bodies in control.

But the composition of an attractive centre is not limited to one such cluster. An union of many of them will form a still more powerful centre of gravitation, whose influence may extend to a whole region of scattered stars. To prove that I argue entirely from observations, I shall mention that another nebula, discovered by Mr.

Mr. Messier in the year 1781, is, by the same instruments, also proved to consist of stars; and though they are seemingly compressed into a much smaller space, and have also the appearance of smaller stars, we may fairly presume that these circumstances are only indications of a greater distance, and that, being a globular cluster, perfectly resembling the former, the distance being allowed for, it is probably not less rich in the number of its component stars. The distance of these two clusters from each other is less than 12 degrees, and we are certain that somewhere in the line joining these two groups there must be a centre of gravitation, far superior in energy to the single power of attraction that can be lodged in either of the clusters.

Investigation of the proper motion of the sun.

I have selected these two remarkable objects merely for their situation, which is very near the line of the direction of the solar motion; but were it necessary to bring farther proof of the existence of combined attractions, the numerous objects of which I have given catalogues * would amply furnish me with arguments.

If a still more powerful but more diffused exertion of attraction should be required than what may be found in the union of clusters, we have hundreds of thousands of stars, not to say millions, contained in very compressed parts of the milky way, some of which have already been pointed out in a former paper †. Many of these immense regions may well occasion the sidereal motions we are required to account for; and a similarity in the direction of these motions will want no illustration.

With regard to the situation of the condensed parts of the milky way, and of the two clusters that have been mentioned, we must remark, that the seat of attraction may be in any part of the heavens whatsoever; for when projectile motions are given to bodies that are retained by an attractive centre, they may have any direction, even that at right angles to its situation not excepted.

* Phil. Trans. for 1786, page 457; for 1789, page 212; for 1802, page 477.

† Ibid. for 1802, page 495.

Investigation of the proper motion of the sun.

It will give additional force to the arguments I have used for the admission of far distant centres of attraction, as well as projectile motions in the stars that are connected with them, when we take notice that, independent of the solar motion, and setting that entirely aside, the action of these causes will be equally required to explain the acknowledged proper motions of the stars. For if the sun be at rest, then Arcturus must actually change its place more than 2″ a year, and consequently this and many other stars, which are well known to change their situation, must be supposed to have projectile motions, and to be subject to the attraction of far distant centres.

Determination of the Quantity of the Solar Motion.

If I am not mistaken, it will now be allowed that no objection can arise against any solar velocity we may fix upon, for want of a cause that may be assigned to act upon the sun, and many stars, so as to account for their motions, and similar tendency toward a certain part of the heavens; we may consequently proceed in examining whether the quantity that has been assumed for calculating the contents of the XIth Table, will sufficiently come up to the conditions we have adopted for directing our determination.

In Fig. 6 we have the velocities of the 36 stars delineated, and by examining the last column of the Table from which they are taken, we find that the parallactic effects arising from the proposed solar motion require the velocity of 18 stars to exceed that of the sun, and exactly the same number to be inferior to it; so far then the rank which has been assigned to the solar motion is a perfect medium among the sidereal velocities.

If we examine in the next place how this motion will agree with a mean rate deduced from the velocities in the above mentioned column, we find a 36th part of their sum to be 1196550. A solar motion, therefore, which agrees with this mean rate will differ from one assigned by the middle rank no more than 0″,079558; and, on account of the smallness of this quantity, the calculations required to lessen it, by some little increase of the solar motion,

motion, might well be dispensed with; but if we were desirous of greater precision, the secondary purpose, next to be considered, would rather incline us to an opposite alteration. Investigation of the proper motion of the sun.

The great disparity of the sidereal motions, which has been mentioned as an incongruity in the first part of this Paper, and has more evidently been shown to exist when we examined the representations of these motions in the 3d figure, is the next point we have to consider in the effect of the solar motion. Let us see how far we have been successful in lessening the ratio these velocities bear to each other. The last column of the Xth Table contains them as they must have been admitted if the sun had been at rest. The proportion of the quickest motion to the slowest is there as 2504621 to 103036; and the velocity of one is therefore above 24 times greater than that of the other. But in consequence of the solar motion we have used, the two extreme velocities are reduced to 2902716 and 395212; which gives a proportion of less than $7\frac{1}{2}$ to 1.

If the quantity of the solar motion were lessened to 1″, we might bring the ratio of the extreme velocities so low as 6 to 1; but as the middle rank has already given it a little below the mean rate, I do not think that we ought to lower it still more; so that when all circumstances are properly considered, there is a great probability that the quantity assumed in the last calculation may not be far from the truth. It appears, therefore, that in the present state of our knowledge of the observed proper motions of the stars, we have sufficient reason to fix upon the quantity of the solar motion to be such as by an eye placed at right angles to its direction, and at the distance of Sirius from us, would be seen to describe annually an arch of 1″,116992 of a degree; and its velocity, till we are acquainted with the real distance of this star, can therefore only be expressed by the proportional number of 1116992.

Concluding Remarks and Inferences.

We have now only to notice a few remarks that may be

Investigation of the proper motion of the sun.

made, by way of objection to the solar motion I have fixed upon. If the quantity of this motion is to be assigned by the mean rank of sidereal velocities, it may be asked, will not the addition of every star, whose proper motion shall be ascertained, destroy that middle rank, which has been established? To this I shall answer, that future observations may certainly afford us more extensive information on the subject, and even show that the solar motion should not exactly hold that middle rank, which from various motives we have been induced to assign to it; but at present it appears, that according to the doctrine of chances, a middle rank among the sidereal velocities must be the fairest choice, and will remain so, unless, what is now a secondary consideration, should hereafter become of more importance than the first. That this should happen is not impossible, when a general knowledge of the proper motions of all the stars of the 1st, 2d, and 3d magnitudes can be obtained; but then the method of calculation that has been traced out in this and the former Paper, is so perfectly applicable to any new lights observation may throw upon the subject, that a more precise and unobjectionable solar motion can be ascertained by it with great facility. Hitherto we find that a mean rank agrees sufficiently with the phenomena that were to be explained: the apparent velocities of Arcturus and Aldebaran, without a solar motion for instance, were to each other, in the IXth Table, as 208 to 12; our present solar motion has shown, that when the deception arising from its parallactic effect is removed by calculation, these velocities are to each other only as 179 to 85, or as 2 to 1. And though Arcturus still remains a star that moves with great velocity, yet in the XIth Table we have 4 or 5 stars with nearly as much motion; and 4 with more.

Our solar motion also removes the deception by which the motion of a star of the consequence of α Orionis is so concealed as hardly to show any velocity; whereas by computation we find that it really moves at a rate which is fully equal to the motion of the sun.

I must now observe, that the result of calculations founded upon facts, such as we must admit the proper

motions

motions of the stars to be, should give us some useful information, either to satisfy the inquisitive mind, or to lead us on to new discoveries. The establishment of the solar motion answers both these ends. We have already seen that it resolves many difficulties relating to the proper motions of the stars, and reconciles apparent contradictions; but our inquiries should not terminate here. We are now in the possession of many concealed motions, and to bring them still more to light, and to add new ones by future observations should become the constant aim of every astronomer.

Investigation of the proper motion of the sun.

This leads me to a subject, which though not new in itself, will henceforth assume a new and promising aspect. An elegant outline of it has long ago been laid before the public in a most valuable paper on general Gravitation, under the form of "Thoughts" on the subject*; but I believe, from what has been said in this Paper, it will now be found that we are within the reach of a link of the chain which connects the principles of the solar and sidereal motions with those that are the cause of orbitual ones.

A discovery of so many hitherto concealed motions, presents us with an interesting view of the construction of that part of the heavens which is immediately around us. The similarity of the directions of the sidereal motions is a strong indication that the stars, having such motions, as well as the sun, are acted upon by some connecting cause, which can only be attraction; and as it has been proved that attraction will not explain the observed phenomena without the existence of projectile motions, it must be allowed to be a necessary inference, that the motions of the stars we have examined are governed by the same two ruling principles which regulate the orbitual motions of the bodies of the solar system. It will also be admitted that we may justly invert the inference, and from the operation of these causes in our system, conclude that their influence upon the sidereal motions will tend to produce a similar effect; by which means the probable motion of the sun, and of the stars in

* See the note Phil. Trans. for 1783, page 283.

orbits,

Investigation of the proper motion of the sun.

orbits, becomes a subject that may receive the assistance of arguments supported by observation.

What has been said in a paragraph of a former Paper, where the sun is placed among the insulated stars *, does not contradict the present idea of its making one of a very extensive system. On the contrary, a connection of this nature has been alluded to in the same Paper†. The insulation ascribed to the sun relates merely to a supposed binary combination with some neighbouring star; and it has now been proved by an example of Arcturus, that the solar motion cannot be occasioned or accounted for by a periodical revolution of the sun and this or any other star about their common centre of gravity.

III.

Explanation of a common Impurity in the Nitrate of Ammonia, which interferes with the production of Nitrous Oxide. By Mr. John Sadler.

Unexpected ebullition and expansion of the nitrate of ammonia.

In attempting to procure nitrous oxide from nitrate of ammonia by heat, it has frequently happened, when I expected the salt to be at the point of decomposition, and nitrous oxide about to be formed, a violent ebullition has taken place, and dense white fumes have been disengaged so rapidly as frequently to burst the retort. When first I observed the fact, I imagined too great a degree of heat had been employed, and the nitrate of ammonia rapidly sublimed and carried over with the nitrous oxide. In my subsequent attempts I endeavoured to guard against the possibility of falling into the same error by increasing the heat gradually and interposing a plate of iron between the bottom of the retort and the furnace when I supposed the heat too intense; yet, notwithstanding these precautions, the same rapid disengagement of dense white

It did not arise from excess of heat.

* See the note Phil. Trans. for 1802, page 478.

† Phil. Trans. for 1802, page 479.

vapours

vapours took place, and continued for a considerable time after the retort had been removed from the fire. The residue in the retort scarcely ever exhibited the same phenomena upon being again subjected to the same treatment; but nitrous oxide was always produced without any farther trouble.

Suspected impurity.

Having frequently procured nitrous oxide without any of the phenomena I have described, I suspected the nitrate of ammonia I had been operating on was impure. I made an examination of the salt, and found it contained a portion of muriate of ammonia. To ascertain whether the muriatic acid had been the cause of the rapid disengagement of white vapour, I took a portion of the same kind of salt I had before made use of, and freed it perfectly from muriatic acid by means of nitrate of silver. The purified salt I introduced into a retort, and proceeding in the usual way, obtained pure nitrous oxide without any of the dense white vapour.

It was muriate of ammonia.

Proof by direct experiment.

To assure myself the presence of the muriatic acid had been the occasion of the facts I observed, I made some pure nitrate of ammonia by the direct combination of pure nitric acid and carbonate of ammonia. I took two portions of the solution, and to one of them added a solution of muriate of ammonia. The two solutions were then crystallised, an equal quantity of each salt was exposed to the heat of an Argand lamp, in glass retorts communicating with the pneumatic trough; the retort containing the compound salt gave out very rapidly a dense opake elastic fluid similar to the white vapours first described; after a short time the evolution of gas became considerably less abundant, and the interior of the retort became clear; the receiver was then changed; upon examination, what came over now was nearly pure nitrous oxide.

Properties of the opake gas obtained from the impure salt,

The first portions of the gas evolved, that is the opake gas, had the following properties:

1st. It remained opake after being passed through cold water.

2nd. A slip of paper coloured blue by tincture of turnsole, when immersed in the gas was changed to red.

3rd. It is not inflammable.

4th. A

4th. A lighted taper is immediately extinguished by immersion in it.

5th. It has a disagreeable acidulous taste, and pungent smell, in which the peculiar odour of nitro-muriatic acid gas is perceptible.

6th. An equal bulk of water did not seem to dissolve any very considerable portion of this gas.

Pure nitrate gives much more of the oxide.

The retort containing the pure nitrate, exposed to the same degree of heat, gave out very soon pure nitrous oxide; but considerably more in quantity; I think considerably above a third more.

It may be observed from what I have detailed, that the presence of muriatic acid is of considerable disadvantage in nitrate of ammonia, when intended for the production of nitrous oxide, the process being rendered by it so much more troublesome, and the quantity of oxide so much less than what is obtained from an equal quantity of pure salt.

I have not observed how small a quantity of muriate affects the process, but considerably under $\frac{1}{8}$ is sufficient to make a disagreeable interruption in the operation.

Farther experiments still wanting.

Many experiments are wanting to point out the peculiar nature of the gas first produced by the decomposition of the impure salt; an examination may probably tend to throw some more light upon the nature of affinities. The subject I think is worth pursuing; at present I have neither the time nor means to give it a farther examination; at some future period I may proceed farther, unless some abler person should take it in hand.

IV.

On the Absorption of Electric Light by different Bodies. In a Letter from Mr. WM. SKRIMSHIRE, Jun. *to* Mr. CUTHBERTSON, *Philosophical Instrument Maker, Poland Street, Soho. Communicated by Mr. Cuthbertson.*

DEAR SIR,

IF you think any of the following facts worthy of publicity, you are at liberty to make what use you please of them.

You know that if a shock be passed through or over the surface of a lump of sugar, the electric light is absorbed, and the sugar becomes luminous. This circumstance induced me to try if other substances did not possess the same property, and with this view I have undertaken a course of experiments, beginning with the calcareous substances, which genus I have already gone through as far as circumstances would permit me. Whether or not the same thing has been undertaken by others I do not know, but as far as my reading enables me to decide, I think it has not; at least with the sole view to the phosphorescence of these substances systematically pursued, the path is clearly untrodden.

Electric light renders sugar luminous.

My mode of making the experiments was as follows:

I placed the substance to be tried on a brass plate, which, by means of a piece of thick wire, was fixed horizontally on the knob of the prime conductor, and endeavouring to take the spark from it by means of the ball of the discharger. It was afterwards placed upon a table, or wooden stand, and the shock from a Leyden phial, first passed over it about a quarter or half an inch above its surface, by resting the points of the discharging rods at an inch or more distance from each other, upon the stone to be tried. It need scarcely be observed that in the following experiments it is necessary to close the eyes until the explosion be heard. Some of the results were very beautiful and curious.

New experiments.

All the calcareous species which I tried were more or

Calcareous spars very luminous by the electric shock, less phosphorescent, and the sparks taken along the surface of a piece of rhombic spar was reflected so intensely as to illuminate the whole table with a brilliant white light.

— particularly chalk. Amongst the aerated species, common chalk was extremely luminous when the shock was passed at some distance above it, and when passed along its surface the fluid left a very vivid zig-zag track of light, which continued for several minutes.

Ketton stone. Next to chalk in its phosphoric appearances was a stone called Ketton stone, which consists of large distinct grains, aggluted together like the roes of fish; in passing the shock along its surface, some portion of the stone was shattered, and its luminous grains dispersed in all directions.

Other bodies. Amongst the several varieties of the sulphate of lime, the specular gypsum, or selenite, is by far the most beautifully phosphoric, but at the same time its light is much more evanescent than in other substances which are less luminous. An oblong six-sided prism of specular selenite shone by the electric explosion with a vivid greenish light, but it continued a very few seconds only. Nitrate of lime fresh made, and tried whilst yet warm, gave small sparks, which upon the surface of the nitrate were quite red, or rather flame-coloured, and it absorbed the electric light but slightly. Muriate of lime was somewhat more phosphorescent than the nitrate. All the fluates absorbed the light freely; the dark purple fluor spars afforded no spark, but allowed the electric fluid to pass in a purple stream, accompanied with a whizzing noise, whilst a yellowish fluor, and another with a greenish tint, which was phosphoric by heat, afforded very good sparks.

Sulphuret of lime particularly luminous. Sulphuret of lime, commonly called Canton's phosphorus, is much the most luminous by the electric explosion of any substance I have hitherto tried, and affords some beautiful experiments, one of which I cannot help mentioning.

Striking and beautiful experiments. Mix sulphate of lime with the white of an egg, and spread it about the tenth of an inch thick upon a piece of board; dry it in the air for a day or two (as it dries very slow),

slow), and when perfectly dry it is very hard; place the ends of the discharging rods upon this substance, about two inches asunder, and take the explosion of a Leyden phial. The fluid does not pass over the surface of the sulphuret quietly, but strips it from the board, and disperses it with violence in every direction, giving the appearance of a beautiful shower of fire.

Phosphate of lime. All the bones which I have tried are luminous by the absorption of electric light, and the enamel of the teeth is still more so; ivory is very phosphorescent by the explosion, and readily perforated by it. The shock from a small phial will perforate from nine to twelve ivory fansticks, and the spark renders these thin slips of ivory transparent. Phosphoret of lime gives a very minute red spark, and is but slightly phosphorescent when the explosion is made above its surface.

Phosphate of lime.

But its most remarkable property is that of being inflammable by means of a very small shock passed through it. As the flame is readily extinguished, a very small piece of the phosphoret, about half the size of a filbert, may be set on fire several times.

—is inflammable by a very small shock.

I have tried many of the testacea and lithophyta, and considering the facility with which all of them imbibed the electric light, I suspect it is a general property belonging to those tribes. The same may be said of all extraneous fossils, which are of a calcareous nature.

Considering how beautifully luminous calcined oyster shells and belemnites are rendered by the electric explosion, I was much surprised to find quick lime fresh from the kiln rank amongst the least phosphorescent of the calcareous genus. Besides the substances here individually specified, I have tried several of the marbles, limestones, stalactites, and spars, all of which were phosphoric.

Quick lime is not rendered luminous.

Should any thing curious occur in my trials with the remaining genera, I shall not fail to inform you, if you think this communication worth acceptance.

I remain your's, &c.

WM. SKRIMSHIRE, Jun.

Wisbech, Oct. 16, 1806.

V.

Description of a Portable Blow Pipe for Chemical Experiments. By W. H. Wollaston, *M.D. Sec. R.S. &c.*

To Mr. Nicholson.

Sir,

Pocket blow pipe.

THE consideration of those instruments which facilitate the attainment of chemical knowledge cannot be thought foreign to the design of a Journal which professes to have for one of its objects the diffusion of chemical information; I am in hopes, therefore, that a short description of a portable pocket blow pipe may be acceptable to many of your readers.

Two tubes slide and draw out, &c.

It consists of three parts, so adapted to each other that they may either be packed together, one within the other, as in Fig. 1. Pl. VIII. which represents them of their actual size, or they may be connected for use, as in Fig. 2. in which the whole is reduced to one half of its real dimensions.

In Fig. 1. the interior tube is shewn to be longer than the exterior; and it is made so, that it may be more readily withdrawn.

In each figure, the upper edge of the large end appears turned outward, in order to diminish the effort of the lips requisite for retaining it in the mouth.

In Fig. 2. it will be seen that the small extremity is placed obliquely (at an angle of about 120°), with the design that the flame impelled by it may be carried to a more convenient distance from the eye, so as to answer the purpose of a longer blow pipe.

This oblique piece is itself composed of three parts, of which the largest is made stronger than the rest of the blow pipe, that it may not be strained by frequent use. One end of this is closed, and into the other is inserted a small peg of wood, perforated so as to receive the tip, which is intended to be occasionally separated, for the purpose of passing a fine needle into it to remove any accidental obstruction.

The

The intention of interposing the piece of wood in this place is, to prevent the communication of heat, which might be inconvenient to the hand that holds the blow pipe.

I remain, Sir,
Your obliged servant,
WM. H. WOLLASTON.

The blow pipe was made by Holtzapfel, Long Acre.

VI.

Experiments on the Growth of White-Thorn. By Sam. Taylor, *Esq. of Moston, near Manchester*.*

TO THE SOCIETY OF ARTS, &c.

Gentlemen,

EVERY one of you, I think, will allow that fences are material objects to be attended to in agriculture; you must also be convinced that there is no plant in this kingdom of which they can so properly be made as the Cratægus Oxyacantha Linnæi, or common White Thorn. In consequence of my being convinced of this, I have been induced to make a few experiments to effect the better propagation of that valuable plant; the result of which, along with specimens of my success, I beg leave to submit to your inspection.

The most valuable fences are made of the white thorn.

In the year 1801, I had occasion to purchase a quantity of thorns, and finding them very dear, I was determined to try some experiments, in order if possible to raise them at a less expense. I tried to propagate them from cuttings of the branches, but with little or no success. I likewise tried if pieces of the root would grow; and I cut from the thorns which I had purchased, about a dozen of such roots as pleased me, and planted them in a border along with those I had bought. To my great astonishment, not one of them died; and in two years they became as good thorns as the average of those I

Experiments for its propagation.

Cuttings of the branches did not grow; those from the roots did.

* Society of Arts, Vol. XXIII.

had

Plants of the white thorn successfully propagated from cuttings of the roots.

had purchased. The thorns I purchased were three years old when I got them. In April 1802, I had occasion to move a fence, from which I procured as many roots of thorns as made me upwards of two thousand cuttings, of which I did not lose five in the hundred.

In the spring of 1803, I likewise planted as many cuttings of thorn roots as I could get. In 1804, I did the same; and this year I shall plant many thousands.

I have sent for your inspection specimens of the produce of 1802, 1803, and 1804, raised after my method, with the best I could get of those raised from haws in the common way, which generally lie one year in the ground before they vegetate. They are all exactly one, two, and three years old, from the day they were planted. I was so pleased with my success in raising so valuable an article to the farming interest of this kingdom, at so trifling an expense, (for it is merely that of cutting the roots into lengths and planting them,) that I was determined to make it known to the world, and could think of no better method than commnnicating it to your Society; and should you so far approve of this method of raising thorns, as to think me entitled to any honorary reward, I shall receive it with gratitude, but shall feel myself amply repaid for any trouble I have been at, should you think it worthy a place in the next volume of your Transactions.

The method of raising the thorns from roots of the plant, is as follows:

I would advise every farmer to purchase a hundred or a thousand thorns, according to the size of his farm, and plant them in his orchard or garden, and when they have attained the thickness of my three-year-old specimens, which is the size I always prefer for planting in fences, let him take them up and prune the roots in the manner I have pruned the specimen sent you, from which he will upon an average get ten or twelve cuttings from each plant, which is as good as thorns of the same thickness; so that you will easily perceive that in three years he will have a succession of plants fit for use, which he may if he pleases increase ten-fold every time he takes them up.

The spring (say in all April) is the best time to plant the

the cuttings, which must be done in rows half a yard asunder, and about four inches from each other in the row; they ought to be about four inches long, and planted with the top one-fourth of an inch out of the ground, and well fastened: otherwise they will not succeed so well.

Plants of the white thorn successfully propagated from cuttings of the roots.

The reason why I prefer spring to autumn for planting the roots, is, that were they to be planted in autumn, they would not have got sufficient hold of the ground before the frost set in, which would raise them all from the ground, and, if not entirely destroy the plants, would oblige the farmer to plant them afresh.

I have attached the produce of my three-year-old specimen to the plants it came from, cut in the way I always practise; on the thick end of the root I make two, and on the other end one cut, by which means the proper end to be planted uppermost, which is the thick one, may easily be known.

Although I recommend the roots to be planted in April, yet the farmer may, where he pleases, take up the thorns he may want, and put the roots he has pruned off into sand or mould, where they will keep until he has leisure to cut them into proper lengths for planting; he will likewise keep them in the same way, until planted.

The great advantage of my plan is: first, that in case any one has raised from haws, a thorn with remarkably large prickles, of vigorous growth, or possessing any other qualification requisite to make a good fence, he may propagate it far better and sooner, from roots, than any other way. Secondly, in three years he may raise from roots a better plant, than can in six years be raised from haws, and with double the quantity of roots; my three-year-old specimen would have been half as big again, had I not been obliged to move all my cuttings the second year after they were planted.

It would not be a bad way, in order to get roots, to plant a hedge in any convenient place, and on each side trench the ground two yards wide, and two grafts deep; from which, every two or three years, a large quantity of roots might be obtained, by trenching the ground over again, and cutting away what roots were found, which

Planks of the white thorn successfully propagated from cuttings of the roots.

which would all be young and of a proper thickness. I do not like them of a larger size than the specimens sent.

I am at present engaged in several experiments, to endeavour to propagate the thorn from the branches, which, if successful, I will communicate to you; but I am of opinion, that what is now done is sufficient.

Should the Society require any further explanations, I shall be happy in doing my utmost to furnish such explanations*.

SAMUEL TAYLOR.

Moston, near Manchester,
May 6th, 1805.

VII.

On the Phantasms produced by Disordered Sensation. In a Letter from a Correspondent.

To Mr. Nicholson.

Sir,

Spectres seen by Nicolai from nervous indisposition.

I HAVE just been perusing in your Journal for Nov. 1803, the Memoir of Nicolai, on spectres which haunted that intelligent and estimable man for two months. His narrative developes many curious topics of investigation, respecting our perceptions, and may perhaps lead to a farther explanation of the laws by which our trains of ideas are governed, and the mechanism of our organs of thought; concerning which, so little is known. The perusal induces me to send you a few more facts relative to the same obscure subject.

These phenomena are by no means uncommon.

Many persons, particularly females, within the circle of my personal knowledge, have related to me incidents of the same nature, arising from nervous indisposition. Nothing is more common than the appearance of figures and sounds in fevers; and they are very frequently exhibited to persons in apparent good health. In all the instances related to me, the parties were aware of the

* Specimens were sent to the Society.

objects

objects being the mere consequences of indisposition, or what may be called internal sensation, and spoke of them as such. It is not a month since I was sitting alone with a lady, for whose powers of mind and moral habits, I have the highest respect, when after a short and sudden pause, she said—"This moment I saw M——— standing in "his usual manner just behind your chair, and a little "while afterwards he was in the corner of the room:" Upon my inquiring respecting the appearance, she said the figure was paler, or less clearly visible, than usual, and that it gradually faded away.

Account of an instance.

I know a gentleman, at present in the vigor of life, who in my opinion is not exceeded by any one, in acquired knowledge, and originality of deep research; and who, for nine months in succession, was always visited by a figure of the same man, threatening to destroy him, at the time of going to rest. It appeared upon his lying down, and instantly disappeared when he resumed the erect posture. This was not related to me by himself, but by another friend, and his absence has since prevented my inquiring farther.

Phantasm which appeared for many months on lying down to rest.

Little doubt remains in my mind, that many of the stories of apparitions, which have been in all ages so generally received, were true, though probably incorrect, from the influence of the imagination under an impression of terror. When I was a boy, I once or twice in the night awoke with the disease commonly called the night-mare; and then the fit was accompanied with a sense of weight, as if caused by a person actually pressing on me, and touching me with cold hands; and in the momentary interval between one crisis and the next, I had a consciousness that that person hurried round the room and came back to torment me again, before I could recover my speech or motion. But afterwards, when I was older and considered these as the effects of disease, I had an attack, in which I experienced no terror, nor had any concomitant notion of an external agent; and as soon as I felt a remission of the rigor, I sprung up and was relieved; no other consequence remaining but a slight tremor of the surface of the body.

Many of the stories of apparitions have been true; but originated in disease, assisted by fancy.

Incubus, or Night-mare.

About twelve years ago, I had an attack of fever, arising

Narrative of the phantasms

produced by disordered sensation in fever.

sing from some deep seated inflammation which caused acute pain in the left side. It was occasioned by a cold caught at the breaking up of the hard frost in the Spring of 1795. The pulse was generally about 110 in the minute, and the illness, which lasted some weeks, was accompanied with disordered perception, through almost its whole duration. My recollections of what then happened, renewed by occasional meditation on the subjects since that time, are now so far impaired, that some of the particulars recur in a less striking manner; the exact order of their succession, and time of their respective duration, are less certain than these would have been, if my first intention of writing down the various phenomena soon after the event, had been carried into effect.

The disorders of perception form a subject of interest, where a law of action can be indicated.

The phantasms or delusions which accompany and mark disordered sensation, (which term I would use in contradistinction to disorder in the powers of memory reasoning or the moral habits) are perhaps too frequent and too little varied, to afford much interest in describing them, unless where the narrative can point out some law which the effects may seem to follow, or may afford some general inferences that may prove valuable as rules of conduct under such sufferings. It must no doubt be a considerable advantage and consolation to those who might ascribe these visions to supernatural powers, or who might be driven to insanity by impatience or terror, on the supposition of reality, for want of knowing these phenomena of disease;—it must, no doubt be highly beneficial that they should have such knowledge: but the events I offer to your readers, are, in my opinion, principally remarkable for a certain connection they shewed with that common law of association, by which our usual train of ideas is so immediately and rapidly governed.

Patients may derive much advantage from being aware of the phenomena.

Commencement. Slight but not permanent defect of memory.

At the commencement of the fever, a slight defect of memory was perceived in forming the phrases for dictating a letter; but this did not last, and I found no difficulty afterwards in performing arithmetical and other processes by memory to as great an extent as my usual habits could have gone. The first night was attended with great anxiety, and the fatiguing and perpetual recurrence of the same dream. I supposed myself to be in

the

the midst of an immense system of mechanical combination, all the parts of which were revolving with extreme rapidity and noise, and at the same time I was impressed with a conviction that the aim or purpose of this distracting operation was to cure my disorder. When the agitation was carried to a certain height, I suddenly awoke, and soon afterwards fell again into a doze, with repetition of the same dream. After many such repetitions it occurred to me that if I could destroy the impression or conviction, there might be a probability that the delirious dream would change its form; and as the most likely method, I thought that by connecting some simple visible object in my mind, with the notion of cure, that object might be made to occupy the situation of the rapidly moving objects in the dream. The consequence, in some measure, answered my expectation; for upon the next access, the recollection of the figure of a bottle, to which I had previously directed my mind, presented itself, the rotation ceased, and my subsequent dreams, though disturbed, were more various and less irritating.

Anxiety: incessant recurrence of the same dream.

This recurrence was prevented by an act of discipline in the mind.

The medical treatment consisted in the external application of leeches to the side, with venesection, and the saline mixture was taken internally.

Medical treatment.

A second night was passed with much agitation in repeated dozing, with dreams, in which, except with regard to the strangeness and inconsistency of the objects that offered themselves, it was difficult to distinguish the time of sleep from that of wakefulness. None of that anxiety of mind remained which had added to the sufferings of the preceding night. When morning came, the state of the sensations had either undergone a change; or it was more easy, as Hartley* remarks, for the real impressions of surrounding objects, to predominate over the phantasms of disease. Being perfectly awake, in full possession of memory, reason and calmness, conversing with those around me, and seeing, without difficulty or impediment, every surrounding object, I was entertained and delighted with a succession of faces, over which I had no control, either as to their appearance, continuance or removal.

Disturbed night:—

—and in the morning, a succession of phantasms of faces succeeding each other for a long time.

* On Man.

Manner of their appearance, duration and change.

They appeared directly before me, one at a time, very suddenly, yet not so much so, but that a second of time might be employed in the emergence of each, as if through a cloud or mist, to its perfect clearness. In this state each face continued five or six seconds, and then vanished, by becoming gradually fainter during about two seconds, till nothing was left but a dark opake mist, in which almost immediately afterwards appeared another face. All these faces were in the highest degree interesting to me, for beauty of form and the variety of expression they manifested of every great and amiable emotion of the human mind. Though their attention was invariably directed to me, and none of them seemed to speak, yet I seemed to read the very soul which gave animation to their lovely and intelligent countenances: admiration and a sentiment of joy and affection when each face appeared, and regret upon its disappearance, kept my mind constantly rivetted to the visions before it; and this state was interrupted only when an intercourse with the persons in the room was proposed or urged.

Theory of Hartley; that the visions of fever are common ideas or thoughts exalted by irritability.

It was in my recollection that Hartley in his work upon Man adopts a theory, that the visions of fever are common ideas of the memory recalled in a system so irritated, that they act nearly with the same force as the objects of immediate sensation, for which they are accordingly mistaken: and therefore it is, says he, that when delirium first begins, if in the dark, the effect may be suspended by bringing in a candle, which by illumination gives the due preponderance to the objects of sense.

It is not the fact.

This, however, I saw was manifestly unfounded. It was in my power to think of absent objects (e. g. of sight) as usual, but they did not appear. The ideas were in the mind as usual, and at the very same time, the real objects of sense, and the objects of diseased sensation stood visible before me.

Ideas, sensations and phantasms can be all distinctly present at once.

When my attention was strongly fixed on the idea of an absent place or thing, the objects of sensation and of delirium were less perceived or regarded. When the mind was left in a passive or indolent state, the objects of delirium were most vivid, and the objects of sensation, or real objects in the room, could not be seen.

But

But when by a sort of exertion, the attention was roused, the phantasms became as it were transparent, and the objects of sensation were seen as if through them. There was not the least difficulty in rendering either object visible at pleasure; for the phantasms would nearly disappear, while the attention was steadily fixed on the real objects. Each particular phantasm was neither hastened nor retarded in its whole appearance or duration by this process.

The voluntary attention of the mind, gives vigour and strength to either of the three, at pleasure.

After a morning passed in this manner, I had a visit from Dr. C——, to whom I related the effects, and among other remarks I observed that I then enjoyed the satisfaction of having cultivated my moral habits, and particularly in having always endeavoured to avoid being the slave of fear. "I think," said I, "that this "is the breaking up of the system, and that it is "now in progress to speedy destruction. In this state, "when the senses have become confused, and no longer "tell me the truth, they still present me with pleasing "fictions, and, my sufferings are mitigated by that calm-"ness which allows me to find amusement in what are "probably the concluding scenes of life."

Advantages of self-command, conversed upon.

I give these self-congratulations without scruple, because I am an anonymous writer, and more particularly because they led to an observation of fact, which deserves notice. When the doctor left me, my relaxed attention returned to the phantasms, and some time afterwards, instead of a pleasing face, a visage of extreme rage appeared, which presented a gun at me and made me start; but it remained the usual time and then gradually faded away.

The phantasms are affected by the conversation.

This immediately shewed me the probability of some connection between my thoughts and these images; for I ascribed the angry phantasm to the general reflection I had formed in conversation with Dr. C———. I recollected some disquisitions of Locke in his Treatise on the Conduct of the Mind, where he endeavours to account for the appearance of faces to persons of nervous habits. It seemed to me, as if faces, in all their modifications, being so associated with our recollections of the affections or passions, would be most likely to offer themselves in delirium: but I now thought it probable that other objects would

And this suggested a connection between the thoughts and the visionary appearances.

Attempt to

alter the appearance of the phantasms,

would be seen if previously meditated upon. With this motive it was that I reflected upon landscapes and scenes of architectural grandeur, while the faces were flashing before me; and after a certain considerable interval of time, of which I can form no precise judgment, a rural scene of hills, vallies and fields appeared before me, which

—which succeeded.

was succeeded by another and another in ceaseless succession; the manner and times of their respective appearance, duration and vanishing being not sensibly different from those of the faces. All the scenes were calm and still, without any strong lights or glare, and delightfully calculated to inspire notions of retirement, peace,

They disappear at the instant of taking a medicine:—

tranquillity and happy meditation. I do not remember how long these lasted, but think it was the next morning that they all vanished, at the very instant of taking a draught, composed of lemon juice, saturated with potash, with a small addition of the pulvis londinensis. I cannot think the effect was owing to any peculiar virtue of this medicine (for it took place before the draught had actually entered the stomach) but merely to the stimulus of the subacid cold fluid.

—but return again, though in other forms.

How long the appearances were suspended, I did not note, or have now forgotten. The fever continued with the same frequency of pulse, and pain in the side, attended with yawning and great increase of suffering while in the prone posture. Notwithstanding the saline antimonial medicine was continued, the figures returned; but they now consisted of books, or parchments, or papers containing printed matter. I do not know whether I read any of them, but am at present inclined to think they were either not distinctly legible or did not remain a sufficient time

—which were changed by volition.

before they vanished. I was now so well aware of the connection of thought with these appearances, that by fixing my mind on the consideration of manuscript instead of the printed type, the papers appeared, after a time, only with manuscript writing: and afterwards by the same process, instead of being erect, they were all inverted or appeared upside down.

Delusions of the sense of hearing.

It occurred to me that all these delusions were of one sense only; namely, the sight; and upon considering the recurrence of sounds, a few simple musical tones were afterwards

afterwards heard, for one time only; soon after which, having dropped asleep, an animal seemed to jump upon my back, with the most shrill and piercing screams, which were too intolerable for the continuance of sleep.

Another mode of delusive perception of visible objects.

Diseased perceptions of the hearing did not again recur, and I do not remember by what gradation it was, that the frequently changing appearances, before the sight, gave place to another mode of delusive perception, which lasted for several days. All the irregularly figured objects, such as the curtains or clothes, were so far transformed that they seemed to afford outlines of figures, of faces, animals, flowers and other objects, perfectly motionless, somewhat in the manner of what fancy, if indulged, may form in the clouds or in the cavity of a fire; but much more complete and perfect, and not to be altered by steady observation or examination. They seemed to be, severally, as perfect as the rest of the objects with which they were combined, and agreed with them in colour and other respects.

I can make so few inferences or observations upon the several other characters, which these diseased sensations assured, that I shall not attempt to describe them.

Various accounts of ocular facts.

Various authors have given narratives which coincide with the preceding, in part; and as analogy is the great clue for investigating the phenomena of nature, I will give a few facts and remarks which may bring us more to a point.

Phantoms of real objects produced by emotion of mind.

None of the phantoms in my illness were of known places, objects or persons. But on another occasion, when I accidentally fell into the sea, and after swimming a certain time without assistance, began to despair of my situation; the image of my dwelling and the accustomed objects appeared with a degree of vividness, little different from that of actual vision. Mr. Sturt, M. P. when greatly in danger some years ago, by being wrecked in a boat, on the Edystone rocks, relates, in an account which appeared in the papers, that his family appeared to him in this extremity. "He thought he saw them." I think both these instances are referable to Hartley's Theory. The illusions of figures appearing to persons near death are very common.

Sleep

Delirium precedes sleep.

Sleep is, I think invariably preceded by a diminished power of judgment and the appearance of phantasms.

Dreams are like the phantasms of fever.

The objects of dreams appear to be of the same class, or description, as those I had in fever. Like them they appear uncontroled by the will for the moment, and resemble the objects for sense; and like them they can be often traced to some preceding thought or incident. Is not a certain degree of debility one of the conditions required for the appearance of these phantasms?

Comparison of the visible and audible perceptions caused by disease.

The ear is much more an instrument of terror than the eye. Diseased perceptions of sight are more common than those of hearing, and they are in general borne with more tranquillity. A few simple sounds usually constitute the amount of what the ear unfaithfully presents; but when incessant half-articulated whispers, sudden calls, threats, obscure murmurs, and distant tollings are heard, the mind is less disposed to patience and calm philosophy. Instances however are not wanting, in which musical combinations of enchanting melody haunt the mind, and occupy the senses of those who are oppressed with indisposition.

I will not make this letter longer by apology. Do with it what you please, and I shall continue,

A grateful sharer
In your labours.

L. M.

VIII.

Early Account of the Bath Waters, by John Mayow. *Extracted in a Letter from* W. R. Clanny, *M.D. Hon. Member of the Royal Philos. Soc. at Edinburgh, Senior Physician to the Durham Infirmary.*

To Mr. Nicholson.

Being lately much engaged in the interesting study of mineral waters, amongst other books on the subject I read with much pleasure a scarce work, entitled, "A Discourse of Bathe, and the Hot Waters there, &c. by Tho. Guidott, M. B. London, 1676." The author has inserted

inserted a translation of Dr. Mayow's Analysis of the Bath Waters, for the purpose of refuting it; and in his zeal to support his own analysis, in which he asserted that the Bath Waters contained nitre and sulphur, he has preserved Dr. Mayow's analysis, which, even at this enlightened period of chemical science, must be esteemed as a superior production. On reading it I was impressed with the idea that it would be interesting to many of your scientific readers, who may not have seen the work I allude to.

Early examination of the Bath waters.

How far Dr. Mayow understood the oxydation of metals his own words will shew; nor will any unprejudiced reader suppose that the thread of science was broken in his hand.

Dr. Mayow's Analysis was published in the Latin language, which I have not seen; but it is rather an advantage to general readers to have a translation in the vernacular language, and being translated by a cotemporary, though a rival Physician, may in some degree assist in fixing our ideas of the meaning of the author.

Since writing the above, Dr. Gebbes' excellent analysis of the Bath Waters has come to hand; his judicious remarks on Dr. Mayow's Analysis preclude me from offering any further observations, except, that by Dr. Mayow's Analysis I was led to understand that the Bath Waters contained iron in a pure state, which is since corroborated by Dr. Gibbes' late communication to your excellent Journal. I shall now give the whole chapter from Mr. Guidott's work, wherein is inserted Dr. Mayow's Analysis.

CHAP. II.

"*The Opinion of a late Author concerning the Nature of the Baths of Bathe.*

Joh. Mayow, L.L.D. & M.D.

"And here I cannot but take notice of a novel writer, who magesterially thus determines: *Quod ad nitrum et sulphur attinet, quibus Thermas Bathonienses imbutas esse hactenus creditum est, eorum neutrum aquis thermarum istarum solutum esse arbitror: As to what concerns nitre and sulphur with which the Baths of Bathe have*

Early examination of the Bath waters.

hitherto been thought to be impregnated, I suppose there is nothing of either of them dissolved in the waters.

" A bold assertion! which had it been vented and believed but fifty years ago, would have prevented much trouble in evincing the contrary; but since 'tis the fashion to be peremptory, I do assert, *That both nitre and sulphur are to be found in all the baths of Bathe, and that dissolved in, and mixed with, the body of the waters.* In order to the proof of which I shall take some account of the forementioned author's XVth Chapter of his tract of Sal-Nitre, the arguments he hath against it, and his opinion to the contrary.

" His words therefore, as well as I can translate them, are these:

" Among the most celebrated bathes, we may justly reckon those of *Bathe*, in which admirable waters a continual vestal and sacred fire is maintained, as if things of a most different nature were interleagued. Before I come to the manner how these bathes receive their heat, it will not be improper if I make some inquiry into the contents of these waters.

" It is therefore manifest, that the bathes of Bathe are impregnated with a certain salt of an acrid nature; for if any sal alkali, or volatile salt purely salined, be mixed with these waters, a precipitation will ensue, and the waters will become turbid, and of a milky nature.

" Moreover, the Bathe waters powred on boyling milk, will coagulate it, as any other acid doth.

" Neither doth this acid salt seem to be the only salt of the Bathe, but is complicated with an alkali; for if the water be evaporated quite away, a certain salt of a more fixed nature will be found in the bottom of the vessel, which, on the powring of any acid on it, will ferment.

" Of the same nature also are the mud and sand of the bathe, which are wrought up with the springs; for any acid liquor being powred on them, an ebullition will follow.

" There may be also observed in these waters a salt, or rather a lime-chalk kind of earth, sticking to the bottom of the gouts, or passages, almost in all places where the water passeth.

From

" From what hath been said may be collected, That the bathes of Bathe are impregnated with a certain acid saline salt; and the salt of the bathe seems not much unlike tartar vitriolated, or aluminous salt. Early examination of the Bath waters.

" The reason why these salts destroy not one another, but each of them ferments with its contrary salt, may be understood from what hath been delivered in the former Chapter; to wit, these salts are so imperfect, that in conjunction they cannot destroy one another. But more of these salts hereafter.

" As to nitre and sulphur, with which the Baines have hitherto been thought to participate, I suppose that neither of them is dissolved in those waters.

" That there is no nitre in the waters appears by this. That the salts that remain after the evaporation of the Bathe Water, put on a coal, burn not as nitre doth. Although I shall not deny, that those immature salts of an alkali nature (which are also contained in the sand and mud of the Bathe) being exposed some time to the air, may, perhaps, by its influence, be converted into nitre.

" As to sulphur, which hath been so much reported to be in all bathes, 'tis not, I believe, dissolved in these waters. Because,

" If a solution of alom, vitriol, or any other salt, whether acid, or fixt, be mixed with the water of the Bathe, sulphur discovers not itself to be precipitated, either by a fetid smell, or any other sign, which notwithstanding in the solution of sulphur in the water of unslack'd lime, or made into lixivium, doth appear, when the sulphur by the effusion of any acid liquor is precipitated.

" I am not ignorant that the water of these bathes, if salt of tartar, or a purely volatile salt, be cast into it, will presently turn white, as is declared before, which colour proceeds not from sulphur, but a stony, or aluminous matter precipitated, not much unlike to what is observed in the water of unslack'd lime, when any fixt salt is mixed therewith; in which, notwithstanding, it is not to be supposed the sulphur is dissolved; for if sulphur be boyled in water of unslack'd lime, the water becomes

Early examination of the Bath waters.

white, not by the effusion of a fixt salt, as before, but of an acid; so that the fixt salts may dissolve sulphur, but not precipitate it. Wherefore if sulphur be contained in the waters of the Bathe they would be precipitated, not by a purely saline, as formerly, but an acid salt, and the sulphur so precipitated would discover itself by a fetid smell, which it doth not do.

"To which I add, that an acid salt, or something aluminous, doth seem to predominate in the bathes aforesaid, so that they become altogether unfit to dissolve the sulphur.

"Moreover, if common sulphur be boyled in those waters they are never tinged with a yellow or sulphurous colour, neither can sulphur by any means be precipitated from the decoction, as I have often experimented.

"And therefore I must admire the famous Willis, in his Treatise of the Heat of the Blood, should affirm, that sulphur boyled in Bathe Water may be dissolved after the same manner, as if boyled in water of unslack'd lime.

"Now if sulphur seems to be dissolved in the waters aforesaid, the occasion of the mistake, I suppose to be, that the decoction was made in a vessel, in which some fixt salt had been decocted, so that the solution of the sulphur may be made by some particle of a fixt salt, with which the vessel might be seasoned.

"Concerning the bathes of Bathe, 'tis the common opinion that silver dipped into them is colored yellow, in the same manner as if it were cast into a solution of sulphur, and hence it is supposed that the Bathes have sulphur in them; but experience evinceth the contrary; for silver put into the Bathe Water becomes not reddish, or yellow, but rather black.

"The mistake may seem to arise from this, that 'tis customary with the Bathe-Guids to tinge and as it were guild over pieces of silver with the salino-sulphurous mud, or dung, such as is often found in houses of office, and put them off to strangers, for a little profit, as if they were coloured with the Bathe-water.

"And here this is to be noted, that a kind of bituminous mud, with a small pittance of common sulphur, is brought

brought up with the springs, which only swims on the top, or else continues at the bottom, but never is dissolved in the waters themselves.

Early examination of the Bath waters.

" Neither is sal armoniack, as some imagine, to be found in these waters, for if on the solution of sal armoniack, salt of tartar be injected, the purely saline volatile salt (of which sal armoniack in part doth consist) being at liberty from the acid salt, to which it was formerly united, will presently fly off into the air, and will quickly be discovered by a pungent affecting the nostrils, which is never observed in the Bathe-waters.

" Lastly, as to vitriol, the Crosse and Hot Bathe seem to have none at all; for if galls are beaten and infused into these waters they neither turn purple nor black, which would certainly be, if these waters had vitriol in them.

" The King's Bathe seems to have a little vitriol in it; for if some beaten galls are cast into that water, it will have a light tincture of a black purple colour.

" 'Tis also to be noted, that a certain mineral of a metallick nature ariseth out of the earth, with springs of the Bathe, which is easily turn'd into vitriol. For if any acid liquor be affused on the sand, (which breaking out with the springs, is found in the bottom of the Bathe,) it being corroded with an acid menstruum, not without a remarkable effervescence, will in part be converted into vitriol, just as it happens to the filings of iron corroded with an acid liquor.

" For if that sand of the Bathe corroded with an acid liquor, be put into the infusion of galls, the liquor acquires an atro-purpureous colour. Whereas if the infusion of galls be put on the sand newly taken out of the bathe, and not corroded with an acid liquor, it will, by no means, be of a purple colour; an apparent sign, that the metallick sand of the Bathe, unless corroded with an acid menstruum, doth not turn to vitriol.

" It is further observable, that the sand of the bathe kept some time, and exposed to the open air, will of its own accord be converted into vitriol; for if that sand be mixed with the infusion of galls, the water will contract an atro-purpureous appearance.

" Moreover,

Early examination of the Bath waters.

"Moreover, if it be laid on the tongue, it hath a perfect vitriolick taste; and no wonder, for the nitro-aereous spirit, after some time, closeth with the metallick mineral, and salino-sulphureous marchasite, of which vitriol useth to be made, mixed in the sand, and causeth it to ferment, and at last, as was shewed before, converts it into vitriol."

Should the above extract prove interesting or amusing to your scientific readers, I shall be much gratified.

I am,
With much respect,
Sir,
Your most obedient servant,
W. R. CLANNY.

Durham, 15*th Nov.* 1806.

IX.

The Improvement of Boggy Land by Irrigation, as carried into Effect. By Mr. William Smith*.

Sir,

Improvement of boggy lands by irrigation.

HAVING paid very considerable attention to improvements of land by irrigation, and applied the water in a manner which I believe to be new and advantageous; I beg leave to submit my account thereof to the Society of Arts, &c. Upon this plan, the rushes and noxious parts are destroyed, the land is rendered firm, and grasses of good quality spring naturally. Even ferruginous waters will have a good effect thus used.

I am, Sir,
Your obedient servant,
William Smith.

Buckingham-Street,
Oct. 31, 1804.

To Charles Taylor, Esq.

* Soc. of Arts, Vol. XXIII. The silver medal was awarded for this communication.

Mode

Mode of improving Boggy Land.

Improvement of boggy lands, by irrigation.

The whole surface of the boggy ground was pared with a breast-plough, and the peaty matter thrown together in ridges, like common high-ploughed land, with a ridge, like a head-ridge, at one end of each set of ridges. Each ridge has a cut or channel for water on the top, and a drain in the furrow or hollow between it and the next ridge. The head-ridge has a larger channel for water on its top, which supplies all the other ridges with water, and this main ridge is itself supplied by its connexion with a larger channel or feeder, which first conveys the water out of the common brook-course into the meadow.

The furrow between each head-ridge and the ends of the beds has a larger drain, into which all the channels of drains in the furrows discharge their water, and which is, by this main drain carried into the brook-course again. Thus the water is diverted out of its usual channel, only to float over the surface of the land, and run into that channel again lower down.

To get the water high enough to swim over the surface of any piece of ground, it is generally necessary to make a dam in the original channel, to pen up the water till it rises to the surface, or near it, and convey it along a channel which shall have less fall than the brook, until it can be got out upon the surface. The length of such conduit or drain must therefore depend upon the fall in the lands which lie parallel to the original channel of the water; and the quantity of land that can be covered with water, depends upon the distance between the proposed new channel and the old ones.

And, to perform this business in the most methodical manner, it is necessary to new model the surface, otherwise the water (which will always find its level) would lie too deep, or move too slowly over the low places in the ground, and thereby injure the grasses by a redundancy of water, while all the higher parts of the ground would appear like little islands above the surface of the water; and consequently receive no benefit from such an imperfect system of irrigation.

Where these inequalities of surface are large and numerous,

Improvement of boggy lands, by irrigation.

rous, it will be attended with much more expense to make such land marks into a regular form for floating, on account of the great expense of wheeling the earth from the hills to the hollows. In these cases, it is necessary (in order to avoid expense) to adopt an irregular method of floating: by taking advantage of such irregularities of surface, a meadow may often be floated at a quarter of the expense required to put it into a regular form, and this method is found to answer the purpose very well, if the works are properly laid out, with the spirit level. When the fall of water is ascertained, the form of the ground is the next thing to be attended to; if there are no natural declivities in the surface, down which the water may run from the overflowings of a cut on the summit into a drain in the hollows, so that the water may keep constantly running down such slopes by a regular current, which prevents a diminution on the ridges and a quick discharge in the lower drain; to avoid an accumulation in the furrows, it must be made with good slopes and plenty of drains; these, with a constant supply of water in the winter, are the most essential parts of a water meadow. The water must be constantly kept moving over the surface, and the practice proves, that where the water moves the quickest, there is always the most grass.

And, as the water must be constantly running off the land, it follows that it must be constantly running on, to keep every part of the surface properly supplied; and this requires a much greater quantity of water than is commonly imagined by those, who are wholly unacquainted with the practice of irrigation. In fact, every good water-meadow should be formed so that it may be said to be nothing but a wide extended channel for the water, no part of which should be too deep to prevent the points of the grass from appearing above its surface, consequently the water cannot be seen when the grass begins to grow. Yet it will still find its way between the shoots, and nourish the grass without bearing it down, or excluding it from the benefit of the air and sun: this is a state, in which the grasses of a water-meadow increase very rapidly; in this state, no water can be seen in any part

part of a meadow, but in the cuts which bring it on and drains that take it off; the motion down the slopes is only perceptible where it runs off the upper cut and in the lower drain; in the still more perfect parts, when the grass has got a considerable shoot, even this part of its motion is not perceptible; and a well-regulated meadow, in the spring, cannot be known to be in a state of irrigation without walking into it. The water running among its shoots, soon becomes perceptible to the foot which proves that there is no inconsiderable quantity running down the slopes, though its motion upon that part cannot be seen.

Improvement of boggy lands, by irrigation.

It is therefore one of the fundamental principles of irrigation, to keep the water moving, and that in such well regulated quantities as shall neither be too great nor too little; for both of the extremes are alike unfriendly to vegetation; but I believe there is much more mischief done to a water-meadow by giving it too little, than too much water, and the greater the supply the less nicety is required in the adjustment, if the meadow is so laid out as to prevent its accumulation in any part thereof. But where the quantity of water is small, it is necessary to be very nice in the distribution of it, in order to receive the full benefit of the stream upon as much land as it is capable of floating.

Here again we must not run into extremes, and try to get the water over too much land at a time, and thereby prevent the grass from receiving the full benefit of a quantity of water which is capable of giving it a good soaking: what that quantity is, will be best determined by practice, for some ground requires much more water than others.

In case of a short supply of water, which is extended to the improvement of as much land as it is capable of covering, according to the best principles of irrigation, it will be better to unite all the water upon such a portion of the work as practice shall prove it capable of covering well, and to let that part have the full benefit of the water as long at a time as is necessary to give a good soaking, or as long as it may be kept off the other parts without injury.

Improvement of boggy lands, by irrigation.

In some meadows, after they have had a complete soaking, which has saturated the soil, and the grass has thickened upon the surface, vegetation will not be retarded for some time for want of water, and those parts which were forced the most in the autumn, will require the least in the spring. It will therefore be always advisable on account of the water and a succession of grass, to get some part of the water-meadow as forward as possible in the autumn, that that part may be dried and fed the first in the spring, while all the water is employed in forcing on those other parts of the meadow which were neglected in the autumn.

By a prudent management of the water in uniting its vegetative powers upon those pieces of meadow which are disposed to produce the earliest vegetation in the spring, and so on in succession, from the earliest to the latest pieces of ground, or those which can be made so; a regular succession of grasses might be obtained, which would be much better than trying to get the whole alike, especially, if the quantity in one person's possession be very considerable, and his quantity of water likely to fail or barely to suffice for the purpose.

This method of using the water in succession upon portions of the meadow, which practice shall prove it capable of covering at one time, will be applicable to most meadows; for there are few, that are well formed, that have too much water, especially in the winter, or where there are any mills or navigations; I have generally observed that the best meadows upon the large streams, are those which have the most water and the best falls.

Account of the Nine Acres of Water Meadow, on Prisley Farm near Fletwick, Westoning, and Tingrith in Bedfordshire.*

As the quantity of water is sometimes insufficient to float the whole of this meadow at once, it has been con-

* A map of this meadow, but without any account of the method of forming it, may be seen in the Communications of the Board of Agriculture, Vol. IV. page 341.

trived

trived to be divided into three parts, by means of two large hatches within the meadow. Each of these principal divisions may again be divided into still smaller parts, by putting a common hatch or board made to the shape of either of the main feeders, which will stop the water out of any part, and force so much the more upon that which is intended to be floated. These contrivances are often necessary on account of the great scarcity of water, and also for the purpose of employing all the water upon any one part of the meadow, while the grass is feeding off the other; and (if the levels will admit of it) something like this ought to be done in every good water-meadow, for it is not merely the elevated or high-ridged form of the surface, which constitutes a good water-meadow, but such a disposition of the parts as is best calculated for the general purposes to which the land, the water, or its produce, may be most advantageously applied. The three parts of this meadow are upon two different levels, so that the drawing of either of the hatches before mentioned lays all the high part dry, and puts either the North or the South part of the lower level afloat at the same time. By keeping down one of those hatches and opening the other, all the water may be turned either upon the North or the South part of the low level, as occasion may require; or if both the hatches be shut down, the whole of the water may be used upon the high level, or two first sets of beds.

Improvement of boggy lands, by irrigation.

If there is more water than is sufficient to float either of the three parts separately, either of the two regulating hatches may be fixed at such a height as to use the remainder on the upper level; or the high level of the meadow may be made to receive its full quantity of water, and an opening be left under one or both of the hatches, so as to distribute the remainder of the water on either of the parts of the lower level, wherever it may be wanting; or the whole of the water may be used upon one of the lower levels, by adjusting the hatch so that that part shall have sufficient water, and drawing up the other high enough to discharge the surplus; or, if one part is floating, and neither of the other pieces in want of water, any overplus may be turned down the waste ditch which di-

Improvement of boggy lands, by irrigation.

vides the meadow from the upland, by drawing the outside or main hatch, high enough to discharge such surplus water under it.

The water is capable of all these variations, but there will seldom be any occasion for turning any water to waste, as it may generally be all employed upon the meadow or upon a third of it. If the other two parts should be in use, it will be found most advisable to feed only one part of such meadow at a time, as the other two-thirds might then be floating alternately.

When that third has been fed off, the most forward of the other two may then be laid dry for feeding, and the new-fed part floated in its stead. By this plan of feeding one-third at a time, and keeping the other two-thirds afloat at the same time, either together or separately, according to the quantity of water, the water will be always constantly employed from the first commencement of floating to the conclusion of the feeding and floating after it; when the whole may be shut up together for mowing.

The spring floating may be continued at intervals, (if the water be not foul) till the grass has gained a considerable height, but it must only be put on for a day or two at a time to cool the ground, and keep the grass growing. This management, if it be well conducted, will be of great service in forwarding the crop and increasing the bulk; the ground will also be the cooler and better for it when the crop comes off, consequently, it will occasion the after-grass to grow so much the quicker. No time should be lost in putting on the water immediately after the hay has been removed; or, as soon as one-third of the meadow can be cleared, the water should be immediately put upon that part till it is pretty well soaked, and then upon the other parts, in their turns, as soon as they are cleared. Great care should be taken both in feeding and taking off the hay, that it be done with a view of clearing that part first, where the water can be first applied to the purpose of producing another crop. The water should never run to waste but in the height of summer, when the grass may be high enough to form a thick cover to the ground, and keep it cool and moist enough for

for the purposes of vegetation without the aid of water; and also at the end of summer or autumn, when, if the meadows are fed with sheep, there may be some danger of rotting them by using the water at this time of the year. It will appear to those who are acquainted with the management of Wiltshire water-meadows (by the account annexed, which I received from his Grace the Duke of Bedford, and which states the quantity of grass cut and the time of feeding the meadow), that the grass was begun to be fed off before it war fit; and, from the long time that the sheep were kept upon the ground during the months of February, March, and April, there was much of the water wasted, which should have hourly been employed at that most prolific season. Experience proves, that there is no danger of getting the grasses too strong upon the ground at this early season, and that crops which are six or seven inches high, and apparently too coarse and high for a bullock to feed, are eaten with the most eagerness by sheep in the spring; and those parts where the grass is the thickest and most luxuriant, are always fed the closest, and sought after with the greatest avidity. This being contrary to the common habits of all animals which graze upon dry pastures, where they give a decided preference to short and sweet herbage, may lead many persons to think that the grass of a water meadow may be too high and luxuriant for sheep; but experience has proved, that such long grass is neither unfriendly nor unsavoury to them; and we know, that the grass always grows the fastest when it has gained considerable height and strength. It will also thicken at the bottom, and the roots will get much stronger hold in the ground, and consequently will not be subject to feel the want of water so soon during the time of feeding, and be able to make a much stronger shoot as soon as it is shut up again, and the water restored to it. The greatest crop will also be of the best quality both in grass and hay, and will always be fed much closer and evener than in those places where the floating has been any ways deficient. The drowner, as he is generally called, or the man who has the superintendance of water-meadows, should therefore endeavour to make every part of the crop as uniform as possible;

Improvement of boggy lands, by irrigation.

Improvement of boggy lands, by irrigation.

possible; for no meadow can be said to be complete till that is accomplished, and a good eye may easily discover the management of a meadow by the crop upon the ground, whether it be in the spring, summer, or autumn: for, if the grass appear patchy, or of different sorts and colours, there can be no doubt but that the water has been partially applied. The different shades of the ground after close feeding and mowing, will also show the parts which have had the most water, and where it has been deficient.

Workmen who have been accustomed to the mowing such crops, can also tell all those parts by the different cut of the grass. Much of the perfection of a water-meadow also depends upon the care and pride which the drowner takes in doing his work well. It would therefore be very advisable not to change those men too often, but to keep the water-meadow constantly under the care of the same workman, so long as he manages it well; and no one should ever alter the water but him who has the constant care of attending it. Water-meadows will never be brought to perfection in any country, till the proprietors and managers of them shall take a pride in doing them well, and strive to rival each other in excellence. Land-owners and agricultural societies should therefore offer premiums for the greatest produce that can be obtained from a given quantity of water-meadow, and a smaller premium to the drowner or managing man. This would excite emulation, and create a conversation and rival spirit of industry, and attention to a pursuit which many might not otherwise have thought about; as the crops of water-meadows are much more at the command of the farmer, and less subject to blight, drought, or uncertainty of season, than any other crop which he cultivates; this would be a fair subject of competition in the skill of the managers, and the premium should not be determined by the produce of a single crop, but by the aggregate produce of the whole year, taken in spring-feed, hay, and autumn-feed.

Account

Account delivered to Mr. Smith, by order of his Grace the Duke of Bedford, of the produce of nine acres from Prisley Water-Meadow, made out of a Bog.

Improvement of boggy lands, by irrigation.

1803. March 29.—Stocked it with 12 score of sheep, kept them three weeks.

April 16.—Shut it up for hay.

June 23.—Cut the first crop of hay, supposed to be above two tons per acre.

August 20.—Cut the second crop, supposed to be one and a half ton per acre.

September 16.—Stocked it with four score of fat sheep, three weeks; after that it was pastured with lean bullocks, as long and as often as they could find food.

1804. February 27.—Stocked it with eight score and four lamb-hogs.

April 28.—They have now been nine weeks. This is more than eighteen sheep to an acre for nine weeks. It had more and better water this last winter than the winter before, but from our want of grass upon the farm, we have eaten it longer than we should have done.

June 21st.—Began cutting the first crop of hay, which is a greater quantity than the year before, and a larger proportion of the best grasses.

N.B. At the Woburn sheep-shearing in June, 1805, the above meadow was examined by the Secretary of the Society, when the quantity of the grass upon it was not only found to be great, but the kinds of grass it produced in general, excellent in quality, and appearing, on comparison, to improve every year.

Reference to the annexed Plan of the six Acres of Water-Meadow, on Prisley Farm.—Plate VIII.

1. The main hatch, which, when closed, occasions the water that is to irrigate the meadow, to flow into the feeder which fills the highest cuts, made upon the first eight

Improvement of boggy lands, by irrigation.

eight ridges, from which cuts it gently glides down the slopes into the eight drains, which unite and discharge themselves under the arch at b.

2. The second hatch, which regulates the water for the ten ridges in the second division of the meadow.

3. The third hatch, which regulates the water for the five ridges in the third or lowest division of the meadow, from whence it falls into the old course of the brook*.

X.

On the Use and Abuse of Popular Sports and Exercises, resembling those of the Greeks and Romans, as a National Object. By SAMUEL ARGENT BARDSLEY, *M.D. From the Memoirs of the Manchester Society, Vol. I.*

(Concluded from p. 222.)

Bull-baiting condemned

ALTHOUGH persons of rank and education, at the present period, have abandoned bear and bull baiting to the lowest and most despicable part of the populace; and even among them these sports are much less frequent than formerly; yet the practice meets with countenance in some parts of the kingdom, and has been supported not long since, in one of the first assemblies of this nation, extolled by men of rank and abilities, as encouraging harmless amusement, manly spirit, and contempt of danger.

These opinions appear to be so much at variance with the present enlightened, liberal, and humane state of society, that to hear they have been defended by serious arguments and with persevering ardor, is sufficient to excite both regret and astonishment. Cruelty in every shape is unjustifiable; but wanton deliberate barbarity is dishonourable to our nature, and contrary to the principles of natural religion, honour, justice, and humanity.

* A certificate, in terms of high approbation, was given by Mr. Farey, of Crown Street, Westminster.

Of

Of all the cruel sports, bull-baiting, as generally practised, is, perhaps, the least defensible. It is not only a cruel, but a foolish and detestable diversion. That the spectacle of two animals endowed with courage, strength and activity, exerting their antipathies to each others destruction, upon fair and equal terms, should excite our curiosity and animate our feelings, is reconcileable to the constitution and nature of man; but that any human being should delight in beholding a noble and useful animal tied to a stake, and deprived in a great measure of the means of offence and defence, and then worried and tormented by dogs and men, is a sport so insipid, so unsportsman-like*, and so cruel, as to excite wonder as well as detestation. But the advocates of these and similar cruel diversions, exclaim in a tone of triumphant interrogation——"Do not these sports inspire manly courage and contempt of danger?"—Certainly not. They are only calculated to generate cruelty and a thirst for blood. They may, indeed, inspire ferocity and insensibility to danger, but they are unfit to impart genuine and manly fortitude.

— on account of baseness and cruelty.

The Romans indulged, as before remarked, in these savage diversions to a greater extent than any other nation of antiquity; yet they did not excel the Greeks, nor

The Romans did not derive courage from these cruel sports.

* Throwing at cocks is another specimen of unmeaning brutality confined solely to our own country. After being familiarized to the barbarous destruction of this courageous bird in the cock-pit, it was only advancing one step further in the progress of cruelty, to fasten this most gallant animal to a stake, in order to murder him piece-meal. This detestable barbarity has declined as our manners have become more polished and humane; but the strong hand of the law was obliged to interfere in many places to hasten its abolition. The cruel treatment of the animal race might well lead an ingenious foreigner† to remark, when describing our popular diversion, as follows: "The women of Rome beheld barbarities and murders in cold blood; but the boxing-matches—the bull-baitings, cock-fightings, and the numerous attendance of both sexes at public executions, indicate that there is at least a remnant of Roman manners, and the taste of those times, left in England."

Cock-fighting.

† Wenderborn, on the character and manners of the people of Great Britain.

have surpassed the moderns, in the display of military ardour and true courage.

It is a superficial and unphilosophical view of the subject, to consider the barbarous sports of Rome contributing to the establishment of her power and military fame. These spectacles never became common till after Hannibal's defeat; and that the Romans, subsequent to this period improved in valour and hardihood, is not recorded in the pages of their history. But may we not, with just pride, appeal to facts furnished by our own age and country? Has the valour, enterprize, or intrepidity of British soldiers and sailors shone less conspicuous, since the period that bull-baiting and other barbarous sports have declined, throughout most parts of the kingdom? The answer is recorded in the history of our late naval and military transactions.

Nor are Spain and Portugal exalted for their bull-fights.

The conduct of the Spaniards and Portugueze, when contrasted with that of our own countrymen, is a striking proof of the incompetency of savage and cruel amusements to create a courageous and warlike disposition. Bull-fights still constitute the only active popular amusement of the two countries. If these bloody sports were capable of inspiring active courage and manly fortitude, how are we to account for the acknowledged degeneracy of the people of Spain and Portugal in these warlike qualities?

Arguments with regard to Britain, and the influence of its sports.

The advocates for bull-baiting and similar sports, have recourse to another argument, or rather assertion, which they urge with great confidence: "Cruel sports," they contend, "do not necessarily generate cruelty in a people." "The English, (say they) who are fond of these diversions, are, at the same time, less ferocious, and indeed hold the shedding of human blood more in abhorrence than any other nation on the face of the globe." Granted that we really deserve this honourable distinction—Does it follow that human nature is differently constituted in England to what it is in other parts of the world? Can it be necessary to prove, that habits of indifference to human suffering are acquired by repeated acts of cruelty to brutes; and that the sympathy of our natures must be blunted in proportion to our familiarity

with

with scenes of unnecessary and wanton barbarity? These are almost self-evident suppositions; at least they are such inductions from daily and repeated experience, as to pass current for intuitive truths. But if we admit that the English are more addicted to cruel sports, and yet hold human life more sacred than the people of other countries, it by no means follows, that such sports have not a tendency to create a disposition to cruelty. How then are we to reconcile this apparent contradiction? The paradox, if there really be any, is not difficult of solution.

Arguments with regard to Britain, and the influence of its sports.

The life of man is always most respected, where it is of most consequence. For, in a country like Britain, where the whole body of the people enjoy political and civil rights, their own importance, and that of their fellow-citizens will be felt and esteemed; and where just and equal laws protect the life and property of the meanest of the people, and consequently private injuries can be redressed by an appeal to the tribunals of justice, man will be less disposed to be the avenger of his own wrongs. Besides, ignorance is commonly the parent of cruelty. Now it may be safely asserted, that the knowledge of man's duties both towards his neighbour and his Creator, are better understood and more widely diffused amongst the mass of the people in this kingdom, than in those otherwise civilized countries, where a thirst for the blood of their fellow-creatures seems chiefly to prevail. These eminent moral and political advantages are the powerful counteracting causes of that spirit of barbarism which cruel diversions are calculated to excite. If it be desirable then to efface the harsh lineaments of rudeness, and a want of feeling nearly allied to brutality, which still mar the otherwise fair visage of the national character, let all barbarous diversions be entirely abolished; but especially let the sport of bull-baiting be the first offering to be sacrificed at the shrines of humanity and justice! "A diversion," to speak of it in the language of a justly celebrated orator*, "which may be charac-

* Sheridan. Parliamentary Debates on the abolition of Bull-baiting, &c.

terised as inhuman, cruel, disgraceful, and beastly, and which can excite nothing but brutality, ferociousness and cowardice; for, its direct tendency is to debase the mind, deaden the feelings, and extinguish every spark of benevolence."

II. The amusements which depend on bodily exercises and personal contests.

On the art of boxing.

It is not compatible with the limits of this essay to notice the variety of bodily exercises and active sports to which the people of England are generally addicted. But there is one kind of personal contest, to the consideration of which the remaining part of these remarks will be chiefly devoted, as it has been the source of obloquy and reprobation among foreigners, to the national character. The public exhibition of boxing, and the practice of the same art in deciding private and personal quarrels, are here alluded to.

Whether pugilism be commendable

The exhibition of pugilism on a public stage, is most probably a relic of one species of the Roman gymnastic. This mode of venal stage-fighting is a barbarous prostitution of a manly and useful art, whether considered as an exercise calculated to inspire fortitude and intrepidity, or to afford efficacious means of defence against personal insult and violence. But when considered merely in the light of yielding gratification as a public spectacle, or of furnishing an opportunity for gambling speculations, it is then viewed in all its naked deformity—Yet, is not the art of boxing, by which instantaneous insult may be avenged, or personal injury averted, less dangerous than any other practice adopted by the inhabitants of the continent on similar occasions and for similar purposes? The question is an important one; and the following facts and observations may serve, perhaps, to apologize for, if they cannot justify, a custom so interwoven with our national manners and character.

It is less dangerous than most other means of sudden combat.

If man cannot be prevented from some appeal to violence, then—

So long as man is subject to the imperfection of his nature, he must be compelled to acquire the art of self-defence, as well as that of annoyance to others. Our experience of his conduct and character, teaches us the impossibility of extinguishing the passions of pride and resentment, which, although they frequently involve him

in

in misery, are still the sources of some of his noblest qualities and attributes. As some portion of evil will attach to the best and wisest system of moral or civil restraint; that policy is, perhaps, the wisest, which legislates for man as he is, not altogether as he ought to be. Suffer the passions to reign uncontrouled, and you dissolve the bonds of society; stifle the active energies of a resolute independent spirit, and you degrade the man into a passive slave. The feeling of resentment for unprovoked injury and insult is a salutary, if not instinctive provision of our common nature. It may be asked—"Is man then to be the judge and avenger of his own wrongs? Is not every offence against the person of a citizen a breach of the laws of society? and should it not be punished as such?"——Certainly:—But if in the best regulated states it be found impracticable to prevent man from frequently asserting a claim to the vindication of his own real or supposed wrongs, it then becomes a question of *expediency* as to the most preferable mode by which he may be enabled to obtain this end. Boxing may not unjustly be considered as the most eligible means of offence and defence. It is properly ranked among those athletic exercises, which, at the same time that they impart address and strength to the body, inspire courage and fortitude in the mind. It may indeed lead *bad* hearts and *bad* heads into acts of presumption and petty tyranny; but this propensity to an improper exertion of skill and courage would be checked, in proportion as men were more *equally* possessed of the means of defence or aggression. They would learn to respect the skill and bravery of each other, and consequently be less prone to undue resentment and quarrels. The government that would attempt, with a despotic and severe authority, to controul the exertions of self-confidence, and a moderate exercise of just resentment, could only expect to rule over a nation of timid and revengeful slaves. The open and ingenuous expression of manly indignation might be repressed; but the rancorous feelings of malignant revenge would be fostered and encouraged. But no state can, with any prospect of success, attempt such an absolute dominion over the passions of men. And if it did,

— boxing is most eligible, for various reasons.

"it

"it must (according to the observation of a spirited author) in order to act consistently, prohibit the use of knives, hatchets, and even pokers; for any of these, upon a sudden emergency, might impart a fearful power to the enraged and the feeble."

Other countries use more destructive means.

If we consider the practice of other countries, where boxing is unknown, we shall find, that the modes of resenting injuries, resorted to by the common people, are full of danger and ferocity. In Italy*, the stiletto is not only the weapon of the hired assassin, but is also kept ready in the bosom of the respectable citizen, to be plunged into the heart of his friend or neighbour, upon any sudden provocation from anger, or motive of revenge.

Destructive effects of want of regulation in personal struggles.

When the passions are under greater restraint, from the influence of laws, of climate and of custom, such dreadful consequences do not ensue from the quarrels of the populace †. Yet even in France, and most parts of Germany, the quarrels of the people are determined by a brutal appeal to force, directed in any manner, however perilous, to the annoyance or destruction of an adversary. Sticks, stones, and every dangerous kind of weapon, are resorted to for the gratification of passion or revenge. But the most common and savage method of settling quarrels upon the continent is the adoption of the Pancratium. The parties close, and struggle to throw each other down; at the same time the teeth and nails are not

* In an authentic publication of the life of the late Pope, it is affirmed, that upwards of 1000 persons annually fall victims in Rome to the stiletto; either by the hands of the hired assassin, or in private quarrels. Dr. Moore reckons the number of murders in Naples, by the dagger, at not less than 400 annually.

† The mode of fighting in Holland, among the seamen and others, is well known by the appellation of Snicker-Snee. In this contest sharp knives are used; and the parties frequently maim, and sometimes, destroy each other. The government deems it necessary to tolerate this savage practice. Certain fines are imposed if wounds be inflicted on dangerous parts of the body; but a very trifling, and indeed seldom any punishment ensues, provided the general rules of the combat have been adhered to.

unemployed.

unemployed. In short, they tear * each other like wild beasts, and never desist from the conflict till their strength is completely exhausted; and thus regardless of any established laws of honour which teach forbearance to a prostrate foe, their cruelty is only terminated by their inability to inflict more mischief. And yet superficial observers, and especially all foreigners who have written concerning our customs and manners, loudly brand the English character with savage rudeness and brutality, because they have seen men terminate their quarrels by an appeal to boxing; in which the parties are not permitted to take an unfair advantage of each other, but when one is disposed to yield, the combat immediately closes, and the conqueror and the vanquished are often seen to give and receive a hearty shake of the hand, in token of mutual good will and forgiveness. In no instance does the manly, spirited, and generous character of Britons, rise to a higher pitch, than in this alacrity almost universally shewn by the most ignorant and lowest order of the people, to terminate their personal contests in a kindly and honourable manner. The mind indeed is thus relieved at once from the brooding mischief of malice and revenge. For, when the idea of self-consequence has been maintained, in courageously supporting the contest, man is better satisfied with himself and others, and consequently more likely to dismiss his ill-will and resentments. In order to foster manly fortitude and vigour, and to prevent the mischiefs arising from the irregular and brutal exertions of strength and ferocity—would it not be advisable to encourage the art of boxing with mufflers, as a subordinate branch of the gymnastic exercises? All *stage* exhibitions of *prize-fighting* ought

In boxing no unfair advantage is ever allowed.

* In Virginia and the other southern states of America, the most savage acts of barbarity are committed, in the quarrels of the people. Gouching—or thrusting out the eye from the socket, is one of the means resorted to upon almost every personal dispute. An intelligent traveller, Mr. Weld, declares, that at Richmond in Virginia, it was nothing uncommon to meet with persons deprived of one or both eyes from this horrid practice. He mentions another mode to disable an antagonist, so detestably barbarous, as to excite incredulity, if the account had not been corroborated by other writers.

to

to be rigidly prohibited; nor should men ever be suffered to prostitute their strength and valour for the sordid purpose of gain.

Where boxing is not used in our country, there is a greater use of barbarous sports.

It is a singular though striking fact, that in those parts of the kingdom where the generous and manly system of pugilism is least practised, and where, for the most part, all personal disputes are decided by the exertion of savage strength and ferocity—a fondness for barbarous and bloody sports is found to prevail. In some parts of Lancashire *bull-baiting* and *man-slaying* are common practices. The knowledge of pugilism as an art is, in these places, neither understood nor practised. There is no established rule of honour to save the weak from the strong, but every man's life is at the mercy of his successful antagonist. The object of each combatant in these disgraceful contests, is, to throw each other prostrate on the ground, and then with hands and feet, teeth and nails, to inflict, at random, every possible degree of injury and torment*. This is not an exaggerated statement of the barbarism still prevailing in many parts of this kingdom. The county assizes for Lancashire afford too many convincing proofs of the increasing mischiefs arising from these savage and disgraceful combats.

Murders prevail more in the Northern Circuit, where they do not box.

The Judges, on these occasions, have frequently declared in the most solemn and impressive charges to the

* A disgusting instance of this ferocious mode of deciding quarrels, was not long since brought forward at the Manchester sessions. It appeared in evidence, that two persons, upon some trifling dispute, at a public-house, agreed to lock themselves up in a room with the landlord and "fight it out" according to the Bolton method. This contest lasted a long time, and was only terminated by the loss of the greatest part of the nose and a part of an ear, belonging to one of the parties, which were actually bitten off by the other, during the fight. The sufferer exhibited at the trial, part of the ear so torn off; and when asked by the counsel, what had become of that part of his nose which was missing—he replied, with perfect naiveté—"That he believed his antagonist had swallowed it!!" It has happened to the writer of these remarks to witness, in more than one instance, the picking up in the streets, lacerated portions of ears and fingers, after these detestable and savage broils. Surely either our laws or manners might interfere in suppressing such deeds of savage barbarity!

Grand

Grand Jury, that the number of persons indicted for murder, or manslaughter, in consequence of the bestial mode of fighting practised in this county, far exceeded that of the whole Northern* circuit; and that, in future, they were determined to punish with the utmost rigour of the law, offenders of this description—But, alas! these just denunciations have little availed. Is it not then highly probable, that the evil which the severity of the law has been unable to correct, might be gradually and effectually abolished, or at least greatly mitigated, by the encouragement of a more manly, and less dangerous mode of terminating the quarrels of the populace? In the Southern parts of this kingdom very rarely (and then chiefly in pitched battles for gain) is there any danger to life or limb from the practice of fair boxing. If then in the public schools and large manufactories of Lancashire, where immense numbers of boys are under the entire controul of their masters and employers, some pains were taken to introduce the manly system of boxing, and the laws of honour, by which it is regulated, there can scarcely be room to doubt, but that the life of man would be more respected—barbarous propensities subdued, and the present character of the county rescued from the stigma of savage rudeness. It has been asserted, by those qualified to judge, that since the late diffusion of the knowledge of the pugilistic art by itinerant practitioners among the Northern inhabitants of this kingdom, the mere exertions of brutal strength and ferocity have somewhat fallen into disuse, both as exercises of pastime, as well as means of offence and defence. In order therefore to abolish all traces of the savage mode of contest which has been so fully described, would it not be adviseable to hold forth prizes, at wakes and public amusements, (where the populace assemble chiefly for the purpose of diversion and pastime) for the encouragement of those, who excelled in sparring with mufflers? This trial of skill, force, and agility (which was at first the practice of the antients) would contribute, *under due regulations*, to

It would be adviseable to introduce boxing into the manufacturing towns, &c.

* At one assizes, no less than nine persons were convicted of manslaughter, originating from these disgraceful encounters.

invigorate the body and animate the courage; and effectually abolish the present dangerous and inhuman method of deciding personal contests.

XI.

Extract from a Memoir of Vauquelin, read to the French National Institute, on the Chemical Properties of Oisanite, compared with those of Titanium, and shewing that the former is the first species of the latter.*

Suspicion of analogy between oisanite and titanium.

SEVERAL years ago, M. Vauquelin indicated an analogy between oisanite and titanium; but as his opportunities at that time permitted him to make experiments upon small quantities only of the oisanite, and the crystalline form seemed inimical to his conjecture, an uncertainty remained which rendered him desirous of repeating his analysis upon a larger scale. It was not till the present year, that by making an excursion into Oisan, he was able to procure a sufficient quantity of that substance for his purpose.

Suspecting that the difference of form and specific gravity between titanium and oisanite might depend on the state of oxidation, he heated equal quantities by the same fire; but no change was produced in either substance. He simply remarked that the titanium became more decidedly red, which was owing to a small quantity of iron contained in it.

They have the same habitudes with alkalies.

Titanium and oisanite comport themselves in the same manner with the alkalies; they combine with them by the assistance of heat, swell up, become white, and are even in part dissolved when water is added to the combination.

It cannot be doubted but that these substances really combine together, because it is impossible to separate them by water or by any other mechanical means. In this state of combination with alkali, the two substances are

* Journal des Mines, No. 114, June, 1806.

soluble

soluble in acids and form triple salts which are easily decomposed by moderate heat.

After having dissolved titanium and oisanite separately in muriatic acid, he subjected them to the action of various re-agents. He remarked that both were precipitated of a fine blood red, by the infusion of nut galls; but that the solution of oisanite afforded a yellowish brown precipitate with prussiate of potash, while the solution of titanium formed a very deep green precipitate with the same re-agent. The author suspected that this last colour might arise from a portion of iron contained in the titanium; he mixed a few drops of muriate of iron with the solution of oisanite, and he then obtained a green colour entirely similar to that which the titanium had exhibited. After having evaporated the solution of titanium to dryness, he washed the residue with distilled water, and obtained a yellow liquid, leaving behind a white substance insoluble in water and the acids; but this matter being again fused with potash and washed to carry off the excess of alkali, was easily dissolved in acids.

The muriatic solutions afford a red precipitate by galls, but the precipitates with prussiate differ owing to iron in the titanium.

The liquor arising from the solution of titanium evaporated to dryness, precipitated a blueish green with prussiate of potash; the solution of the residue being again fused with potash, was, on the contrary, precipitated of a yellowish brown, like that of oisanite, by the same agent and not green as before.

They do not differ when purified.

By this operation, M. Vauquelin having separated the iron from titanium, the solution of the latter then presented absolutely the same properties as those of oisanite. Hence he concludes that the only difference between oisanite and titanium consists in a small quantity of iron and of manganese contained in the latter; but he doubts whether these substances be the cause of the form which distinguishes the oisanite; for these impurities are very small in quantity and may be for the most part separated by muriatic acid.

Oisanite is therefore the first species of the genus titanium.

From these experiments of Vauquelin, it is necessary that oisanite should be removed from the class of stones and placed in that of the metals, under the genus titanium, of which it ought to constitute the first species.

The editors of the Journal des Mines remark in a note that M. Hauy had already conjectured, as was announced in their 61st number, that oisanite, which he denominates anatase, must include a metallic substance. His observations on the form and several other characters of that mineral prove that it constitutes a particular species, which must be separated from the oxides of titanium and placed in the genus of the metal itself.

SCIENTIFIC NEWS.

A Report of the Transactions of the Class of Mathematical and Physical Sciences of the National Institute of France for the preceding Year, was made at the public Meeting of the 7th of July last, of which the following is an Abridgement.

Topography of Persia, extreme dryness and sterility of the soil, &c.

M. OLIVIER presented an account of the "Topography of Persia." He has described the chains of mountains, the courses of the streams, and the productions peculiar to the climate. The nearly absolute drought which prevails, is the cause why not more than one twentieth part of this vast empire is cultivated. Entire provinces have not a single tree which is not planted and watered by the hands of men. This evil constantly increases by the dilapidation of the canals by which the water from the mountains was formerly conducted to the lands, and the territory becoming impregnated with salt, becomes eternally barren.

Conjectures of Lacepede respecting seas and lakes in the interior of Africa.

The reflections of the studious and sedentary cultivator of natural history, may lead to results well calculated to divert the pursuits of travellers. M. de Lacepede, by examining what is at present known of Africa, by comparing the volume of the rivers which arrive at the sea, with the extent of the regions upon which the rains of the torrid zone fall, and the quantity of evaporation to be observed, and lastly, assisting his judgment by the number and direction of the chains of inland mountains, as described by travellers, has offered some conjectures respecting the physical disposition of the countries

countries still unknown in the centre of that quarter of the globe, and more particularly the seas and great lakes which he thinks must there exist. He has indicated the courses which appear to him to be proper for most speedily exploring those countries which still remain to be discovered.

Diminution of the Caspian Sea. Its antient state.

There is another description of conjectural geography, which seems to determine the antient state of places, from what is at present to be seen. M. Olivier has in this manner examined how far it may be admitted that a communication formerly existed between the Caspian and the Black Sea. He thinks it existed to the north of Caucasus, and that the alluvions of the Couban, the Wolga, and the Dou have interrupted it.

Since that time, the Caspian not receiving from the rivers which fall into it a sufficient quantity of water to supply its evaporation, has continually sunk in its level, and is at present sixty feet lower than the Euxine Sea. In this manner it is that it has been separated from the sea of Aral, and has left uncovered the immense plains of salt sand which surround it to the north and to the east.

M. Dereau de la Malle, son of one of the members of the Institute, has found numerous testimonies in the Greek and Roman authors of this ancient extent of the Caspian Sea, and his communications with the Euxine and the Aral. He has presented a long memoir on the subject to the Class, and to that of Ancient History and Literature. These researches afford an additional proof of the utility of connecting the exact sciences, with researches of erudition.

Ancient mill stones.

M. Monges has given some observations on two antient mill stones, dug up near Abbeville, from which, as well as from examination into the writings of the antients, he determines, that they made their mill stones in general of porous basaltes.

Piece goods formed by the loom in antient times.

M. Desmarets, from an examination of some antient garments, found in a tomb of the Abbey of St. Germain, has determined that most of the processes of weaving, at present used, were known in the 10th century, and he has thrown new light upon the articles of Pliny respecting the antient fabrics.

Several

Botanical works.

Several important botanical works have appeared. The Flora of New Holland, by M. de la Billardiere; the magnificent description of the Garden of Malmaison, by Ventenat, have arrived at their nineteenth livraison. The Flora of Ovare and of Benin, by M. De Beauvois is at its fifth. A fifth volume of the Botaniste Cultivateur of Dumont Courset has appeared, and M. La Marck has given in conjunction with M. Decandolle, a third edition, greatly enlarged, of his Flora Française.

M. de Beauvois has begun to publish the insects which he collected on the African and American Coasts. Two parts have appeared.

Cuvier on animals without vertebræ.

M. Cuvier has continued the two great series of researches which he has been engaged upon several years, upon animals without vertebræ, and upon the fossil bones of quadrupeds. In the first of these series he has this year given the anatomy of seven genera; the Scylla, the Glaucus, the Eolides, the Colymacon, the Limax, the Limnæ, and the Planorbe. The two first are very little known, even externally, and the author has rectified the false notions of naturalists with regard to them.

In the second series he treats of the fossil bones of bears, rhinoceros, and elephants.

And on the fossil bones of animals.

Two species of bears, at present unknown are buried with tygers, hyenas, and other carnivorous animals in a great number of caverns in the mountains of Hungary and Germany.

Fossil bones of the rhinoceros and elephant.

Bones of the rhinoceros are found in abundance in the uncompact grounds in all parts of the globe, where excavations have been made. The author has collected notices of more than six hundred places of the two continents, where the bones of elephants have been dug up, and very recently the grinders and tusks have been found in the forest of Bondy, in digging the canal which is intended to bring the waters of the river Ourque to Paris. The more we advance to the north, the better is the state of preservation of these bones. An island of the Icy Ocean is almost entirely formed of them.

—belong to extinct species.

These facts were in great part known; but it follows from the detailed comparison made by Cuvier, of the bones of the rhinoceros and elephants at present living in Africa and

and the Indies, with those of the fossil animals, that they are respectively of different species.

—having peculiar characters.

The fossil rhinoceros had shorter legs, a larger head, of greater length, the snout being very differently formed from that of the present rhinoceros. The elephants had the grinders, the head, and particularly the alveoli of the tusks very differently constructed, and the trunk had other proportions.

—which formerly lived where their bones are now found.

The author concludes therefore that these two species are extinct, as well as so many others of which he has discovered the bones and ascertained the characters, and of which ten or twelve hitherto unknown to all naturalists, have their bones incrusted in the plaster stones of the neighbourhood of Paris.

He also thinks that these species have lived in the places where their bones are found, and that they have not been brought thither as has been generally thought, by an inundation, for their bones are not worn by friction.

Chemical news

The chemical transactions of the preceding twelvemonth which bear relation to the Institute, are mentioned in this report. The new edition of Fourcroy's Philosophy of Chemistry, The Experiments of Count Rumford on the Communication of Heat through Water, and on the adherence of the particles of that fluid together, both which have appeared in our Journal, are stated by the reporter. He also gives a short analysis of the Labours of Berthollet on Chemical Statics, which that able chemist still continues to pursue. M. Berthollet, while he shews that very large quantities of carbonic acid, may, by pressure, be united with the alkalis and earths, takes notice at the same time that these combinations are complete throughout, and not that, as is commonly imagined, one of the principles is superabundant, and as it were disengaged while in excess beyond saturation. In proof of this he remarks that the smallest drop of sulphuric acid, added to a sub-carbonate, does not seize upon a portion of free alkali, but immediately decomposes a portion of the whole salt, and disengages the carbonic acid. And so likewise he remarks that the acidulous sulphate of soda effloresces in the air, which it could not do if any portion of sulphuric

Researches on the chemical affinities, by Berthollet.

ric acid were uncombined; for there is no substance in nature which is more strongly attractive of water.

Measure of the degrees of acidity in different acids compared together.

M. Berthollet has established a method for ascertaining the degree of acidity of the acids, and of the alcalinity of the different bases, by the quantity required of each to saturate or completely neutralize the other, so as to give no sign of either acid or alkaline qualities.

He confirms this method by shewing that the proportions of these quantities are constant, and that if, for example, it be necessary to add to any base twice as much of any species of acid to saturate it as to saturate another base, the former of these two bases will require twice as much of any other species of acid for its saturation as the second will require.

Combinations disunited by heat more readily when water is present.

But the degree of resistance to heat does not correspond with this force, and it is more easy for example, to decompose the carbonate of magnesia than that of lime, by fire, though the affinity of these two earths for the acid is nearly the same. This difference arises from the much greater quantity of water in the first carbonate; and other experiments shew that water favours the disengagement of carbonic acid.

Extensive consequences of this doctrine.

The consequences of these facts, with regard to all the branches of chemistry, particularly the theory of analysis are very important. The tables of affinities and great part of the analyses hitherto made are shaken, and experiment proves in fact that most of these results demand further revision. For example, Klaproth, and after him Vauquelin have found one fifth of fluoric acid in the topaz where it was never suspected. This stone must therefore be ranged among acidiferous substances. Another mineral hitherto considered as a stone, namely the oisanite, must be ranged among the metals; (for which see our present number) and various other instances no less striking and important, are given by the reporter.

History of the late discoveries on platina.

M. Fourcroy has given an account of his experiments on platina, with an history of what has been done by others. Of this last, in abridgement, I give the substance without undertaking to examine into the facts and dates myself.

Descotils attempting to discover the cause of the different

ent colours of the triple salts of platina found that the red colour of some of them was owing to an unknown metal. Fourcroy and Vauquelin, by examining the black powder which remains after dissolving platina, and finding that in some experiments, a metallic vapour having a strong smell was elevated, and that in others, the substance was exhibited in a more fixed manner, considered this powder as a new metallic substance, of which they attributed the different properties to different degrees of oxygenation.

But during this time, Mr. Tennant examined the same black powder at London, and succeeded in decomposing it into two different metals, the one fixed, and the other very volatile; and Dr. Wollaston, another English chemist, by examining the solution which was till then supposed to contain only platina, had also discovered two other metals, different from platina and from those which form the black powder.

So that after the long and painful researches of which this singular metal has been the object for upwards of forty years, chemistry has succeeded in developing eleven metallic substances in its ore; namely, platina, gold, silver, iron, chromium, and titanium discovered by Messrs. Fourcroy and Vauquelin in the more or less coloured sands which are always mixed with it, the two new metals of Wollaston, Palladium and Rhodium, and the other two of Tennant, namely, iridium and osmium.

Short descriptions of these are given, which I shall also transcribe.

Description of Palladium.

Palladium is white, ductile, heavier than silver, very fusible with sulphur, soluble in nitric acid, forming a red solution, precipitable in the metallic state by sulphate of iron, and of a dirty green by prussiate of potash; and forming with soda a triple salt, soluble in alcohol. It was for a short time considered as an alloy of platina and mercury.

—of rhodium.

Rhodium is grey, easily reducible, fixed and infusible, colouring its acid solutions of a rose red, which muriate of tin renders very intense; precipitable of a yellow colour, by the alkalis, and not at all by prussiate of potash. Its triple salt with soda is insoluble in alcohol.

— of iridium. Iridium is white, very hard, difficult to fuse, nearly insoluble in nitro-muriatic acid, and not at all in any other; oxidable and soluble by the fixed alkalis; and its oxide is soluble in acids, giving varied and lively colours to its different solutions. These are the red salts which colour those of platina.

— of osmium. Osmium is a metal not hitherto reducible, of which the oxide has the form of a black and very volatile powder, very odorant, very fusible, soluble in water, and rising with it in vapour, and giving a strong smell and taste to that fluid. Its solution assumes a fine blue colour by the smallest quantity of infusion of nut galls.

The singularity of this composition is no less worthy of remark than the sagacity by which it has been developed.

Discovery of chromium in meteoric stones. Chromium has lately been discovered in the meteoric stones by M. Laugier, and since by Mr. Thenard.

Whether the composition of muriatic acid, announced by Pacchiani, can be depended on. The discovery of Pacchiani, of the formation of muriatic acid, by galvanism, is considered as in want of confirmation, since Messrs. Biot and Thenard did not find it when they took care to make the experiment without the presence of any thing which could afford sea salt. The experiments of Mr. Sylvester, recorded in our Journal, Vol. XV. p. 50, however appear to confirm the fact, and conduce not a little to explain the process, which no doubt must be considered as still enveloped in obscurity.

Curious and useful researches of Biot upon refraction. In a series of researches upon refraction, undertaken in the first instance for the improvement of astronomy, M. Biot was led to avail himself of this action of bodies upon light as a very happy means of analizing transparent substances.

It has been long known that the rays of light are refracted when they pass from one medium into another of different density, and that the refractions of different mediums correspond with their densities, unless they contain some combustible element. These last increase the refraction much beyond what the simple density would have produced.

From this antient observation it was that Newton formed a judgment that the diamond must be combustible, and he even arrived at the almost incredibly acute conjecture,

jecture, that water must contain some combustible matter.

The proportion of parts in known compounds, if transparent, may be determined from their refractive power.

If two substances be mixed of known refractions and proportions, and regard be had to the density of the mixture, the total refraction may be calculated; and, on the other hand, when the refraction of a mixture of which the elements are known is ascertained, their proportion may also be had. Mr. Delambre, in his report, explains the principles of this calculation.

Mr. Biot having applied it to mixtures of known proportions, and having always found it just, has made use of it to determine the unknown proportions of other mixtures.

Method of making the experiment

For this purpose it is only needful to fill a prism of glass, under a known pressure, with the substance intended to be examined; or, to form a prism of it, if it be solid, through which a remote object is to be observed; the angle of refraction is to be measured with the circle of repetition, keeping an account of the pressure, the heat, and the humidity of the external air; and this method being susceptible of a precision equal to that of astronomical processes, necessarily surpasses all our chemical processes in accuracy. But it must also be remembered that it is applicable only to transparent substances, of which the principles are known as to their nature or species.

particularly applicable to the gases.

It is particularly useful to give perfection to the analysis of gasiform substances, and Mr. Biot has already obtained interesting results in this respect.

Oxigen refracts the least, and hidrogen the most, at equal densities. The refractions of the same gas are strictly proportional to its densities when the temperature is constant. Strongly refracting substances appear to owe their force particularly to hidrogen, for they all contain it. Atmospheric air gives exactly, by experiment, the refraction which, according to calculation, ought to be produced by a mixture of 210 oxygen, 787 azote, and 3 carbonic acid. The application of the rule is found to hold not only in simple mixtures, but in more intimate combinations, provided no very considerable condensation has been produced. Thus ammoniacal gas

Common air and other gases tried.

produces the effect indicated by the quantities of azote and of hydrogen which enter into its composition; but if the condensation be too great, there is some alteration though very small. Such is the case with water.

Muriatic acid gas.

The examination of muriatic acid gas, made after these principles, shews that its radical cannot be azote; and also that it cannot be an oxide of hydrogen, containing less oxygen than water.

The diamond inferred to contain hidrogen.

The refraction of the diamond being much stronger than that which is indicated for carbon by the refractions of carbonic acid, alcohol, ether, and other substances of which carbon makes a part; M. Biot concludes, that the diamond cannot be pure carbon, and that we must admit at least one-fourth of hydrogen to satisfy the results of the experiment.

The examination of animal and vegetable products has been carried on with activity and effect.

New principle in asparagus.

The crystalline and soluble principle in asparagus, which is neither acid nor neutral, and does not affect the ordinary re-agents, has been discovered by Vauquelin and Robiquet. The account has already been inserted in our Journal. Vol. XV. 242.

Saccharine matter in bile.

M. Thenard, Professor of the College of France, has completely ascertained the existence in the bile of a saccharine matter which serves to keep the oily part in solution. His methods of analysis are such as do great credit to his sagacity.

Component parts of coffee.

Seguin has made experiments on coffee, which he finds to consist of albumen, oil, a peculiar principle which he calls the bitter principle, and a green matter which is a combination of this last with albumen. He finds that the proportions vary in different specimens; that torrifaction augments the proportion of the bitter principle by destroying the albumen; that these two last principles contain much azote; and that the bitter principle is antiseptic. The oil of coffee is without smell, congelable, and white.

Albumen in vegetables.

Mr. Seguin has discovered albumen in a great number of other vegetables, and most of them contain a bitter principle, in some respects similar to that of coffee.

From the remarkable quantity of albumen found in vegetable

vegetable juices which ferment without yeast, and afford a vinous liquor, this chemist was led to inquire whether the albumen might not be of essential consequence to this intestine motion which is still so little understood. He assures us, that having deprived these juices of albumen they became incapable of fermenting, and that having artificially supplied this principle, such, for example, as white of egg to saccharine matter, the fermentation took place when other circumstances were suitable, and a matter similar to yeast was deposited which appeared to him to be only the albumen which was altered so as to be nearly insoluble without having lost its fermentescible action. Hence he concludes that albumen, whether animal or vegetable is the true ferment.

—is the principle of fermentation.

Mr. Seguin has further ascertained that albumen is found in three different degrees of insolubility and disposition to become fibrous; that the more it is soluble, the more powerful is its action; that the respective proportions of albumen and of sugar in the different juices determine the vinous or acetous nature of the product of fermentation, the product being more spirituous, the greater the quantity of sugar; and lastly, that most of the fermentable juices contain a bitter principle analogous to that of coffee, which is of no effect in the fermentation, but contributes to the taste and preservation of the fermented liquor.

Interesting facts relating to fermentation.

Tannin, the vegetable principle formerly discovered by Seguin, and of which the character is to form an insoluble compound with gelatine, has been again examined by Bouillon la Grange, Professor at the Napoleon Lyceum.

New facts respecting tannin.

He has found that it has an affinity for the alkalis, the earths, and the metallic oxides, and the faculty of becoming converted into gallic acid by absorbing oxigen.

The tannins extracted from different vegetables vary a little in their composition; and that which was discovered by Mr. Hatchett, of London, in such great abundance in cachou is rather more oxigenated than the others.

An Italian chemist, Morichini, having discovered fluoric acid in the enamel of the fossile grinders of the elephant, analized the enamel of human teeth, and supposed

Fluoric acid in fossil teeth.

posed he had obtained the same principle. Mr. Gay Lussac finds it likewise in ivory, as well when fresh as when in the fossil state, and also in the tusks of the boar.

Messrs. Fourcroy and Vauquelin have repeated these experiments, and have, in fact, obtained this acid from tusks and teeth altered by their continuance in the earth, but not from the same parts when fresh, nor even in those which were fossil and had undergone no change.

The experiments of Vauquelin upon hair have already appeared in our Journal. Vol. XV. 141.

The nature of Roman alum explained.

Clement and Desormes have made experiments to imitate the Roman alum, in which they have perfectly succeeded in the large way. Their method consisted in calcination and recrystallization, which afforded an alum deprived of part of its superabundant acid. Curaudeau asserts, that it is also necessary that the small quantity of iron usually contained in alum should be oxided to the maximum for this purpose. But in a later memoir Thenard and Roard appear to have completely disposed of the subject. They have ascertained that one thousandth part of iron has an influence on the effect of alum in dying; that the efforts of the alum maker ought to be directed to clear this salt from that minute quantity; that the oxigenation produces this effect by rendering the iron insoluble; and lastly, that well purified alum is of equal value for manufacturing processes with that of Rome.

Fumigation by oxi-muriatic acid.

The application of the oxygenated muriatic gas to prevent the effects of contagion, as pointed out by Guyton, has been strongly confirmed in the hospitals of France; and it is asserted to have produced the happiest effects as a preservative against the yellow fever in Spain.

Anatomical notices.

Many interesting anatomical researches by Turpin, Cuvier, Tenon, Laumanier, Pictet, Duvernay, Damas, and others, have enriched the year preceding the session of July last.

The report concerning the mathematical transactions of the Class of Science was given by Delambre.

The antient measure of a degree in Lapland was erroneous;—

In the question which has arisen on the subject of the new measure of a degree in Lapland, in which the cause of the error committed in 1736 is required to be ascertained,

tained, Mr. Lalande has sought in his long experience for facts which might answer that purpose. He has remarked, that at that time the use of the telescope of verification (lunette d'épreuve) was entirely unknown. This very commodious and simple instrument, which might be supposed of as early an invention as the application of telescopes to sectors and quadrants, is more modern than might be imagined. We possess the advantage of this, as well as of many other articles of daily use, without inquiring after their inventors. It is mentioned for the first time in the edition of Lalande's Astronomy, of 1764. In order to verify the parallelism of telescopes, Bouguer adopted the use of two pins or studs, which were mutually to be changed in place, in order to ascertain whether they had really the same height. He himself made use of a more imperfect method, which is still less entitled than the studs to be put in competition with the proof telescope of Lalande, which is at present universally adopted. We do not know whether Graham had some equivalent method of approximation to verify his sector. Maupertuis makes no mention of any such thing in the chapter wherein he treats of the verification of that instrument, and this neglect may in part explain the error which is imputed to him.

—because the telescope of verification was not then known.

Mr. Legendre has been busied upon a question of importance, though of rare application. His memoir is entitled, "Analysis of Triangles traced on the Spheroid."

Spheroidal triangles treated by Legendre.

The early astronomers who measured the earth with some exactness, considered it as a sphere of immense radius, in comparison with the small intervals they proposed to ascertain. The greatest side of any triangle in these operations does not exceed 60,000 metres, and the difference between such an arc and the right line that would connect its extremities, is scarcely two decimeters, or the three hundred thousandth part. It was therefore, with reason, supposed that triangles of so minute a curvature might be considered as right lined.

In the latter operations wherein it was sought to determine more exactly the difference between the terrestrial globe and a perfect sphere, an attention to accuracy was carried farther. The triangles formed at the surface of

of the earth were considered as very minute portions of a sphere, which, in all the extent of each triangle was confounded with the spheroid.

Does this supposition, though less inaccurate than the preceding, promise all the precision which it seems fair to expect from it? and since it is a spheroid which is to be measured, why not calculate the triangles as spheroidal? This question is so obvious that it must at once have offered itself to the astronomers charged with the operation, and to each of the learned men, united from the different parts of Europe, to examine and form a judgement of the work which had been executed. In one of the first meetings of the commission, a learned foreigner, M. Tralles, remarked that the bases of Melun and Perpignan could not be simply considered as arcs which should be throughout in the same place, but as curves of double curvature. This remark was made by Clairaut above fifty years before; but it was always thought that the effect of the double curvature could not become even a little perceptible, unless upon intervals much greater than we can directly measure; and it was concluded that considerations of the spheroid would only add an useless degree of complication to calculations already too complex. In fact, the spheroid differs from the sphere much less than the sphere itself does from a plane. Now the sphericity of the triangles does not introduce any terms into the calculations but those of the second order for the angles, and of the third for the sides. It was therefore natural to think that the terms dependant on the spheroid would be of an order more elevated, and still less sensible on account of their extreme minuteness. But no one yet had written on the subject; it was not to be supposed that the astronomers would rest contented with vague considerations and a simple probability. This point, they inform us will be found discussed in the article "Calculation of the Triangles," in the second volume of the Meridian, at present in the press; in which it will be demonstrated, from considerations of great simplicity and elementary throughout, that the difference between the spherical and spheroidal angles of the greatest of their triangles, is not one sixtieth of a second, and that the double

double curvature does not change the longest of their sides nearly so much as one centimetre. These results are confirmed by anticipation in the learned analysis of Legendre.

[The Conclusion of this Report in our next.]

University of Gottingen.

The foreign Journals give accounts of the new modeling of the constitution of this University, under the Prussian government, which the disastrous events of war have since shaken to its centre. I shall not copy this part of their intelligence, so little likely to be permanent, but shall confine myself to the notice of the first part of the Meteorologic Researches, which Professor Mayer has read to the Society.

Mayer on planetary affinity or influence.

In this paper he treats of the chemical affinity of the heavenly bodies, or the influence they appear to exercise upon each other independent of gravity, which influence is manifested in their atmospheres. He particularly attends to that of the moon upon ours, which leads him to treat of globes of fire, and stones, said to have fallen from the sky. He remarks, that almost all these phenomena have taken place when the moon was near one of its nodes, and in that half of its orbit in which its light is on the wane. In the cases which seem to oppose this observation, the coincidence of the passage of the moon through one of these nodes, with its last quarter, took place the preceding lunation. Thus it was in 1803, in the lunation which preceded that of the shower of stones at L'Aigle.

Academy of Useful Sciences at Erfurt.

In the ordinary sitting of the Academy of Useful Sciences at Erfurt, on the 4th of March, M. Bucholz presented a memoir, transmitted by M. Tromsdorff, intitled, "New Experiments to afford a more accurate knowledge of the Ore of Platina." The author endeavours to

Ore of platina.

reconcile the contradictions of the English and French chemists relative to this metal. After a long series of experiments, he has found that Platina, in its crude state, contains also four other metals, osmium, iridium, rhodium, and palladium, and he gives the characters of each.

Iceland crystal. Professor Bernhardi communicated some researches on the double refraction of Iceland crystal, or the crystallized carbonate of lime, in which he has noted the phenomena with greater precision than has hitherto been done.

Lycopodium. M. Bucholz communicated the results of his experiments on the seeds of Lycopodium, which afford new views respecting this vegetable product. 1. The seed of lycopodium contains one-sixteenth part of a fat oil, of a brownish yellow colour, and soluble in alcohol. 2. A portion of true sugar. 3. A viscid extract, of a brownish yellow colour and insipid taste. 4. The residue, after treatment with alcohol and water, appears entitled to be considered as a peculiar product of the vegetable kingdom. 5. The yellowish appearance of the seeds in this last state, appears to indicate the union of a kind of pigment with the first principles of the seed, or at least a very intimate union of the constituent parts of this seed. 6. It is the oily part that enters into the composition of this seed which renders it so speedily combustible, and causes it so immediately to separate from water.

Wirtemberg.

Prize for the best theory respecting fossil bones. M. Caula, Banker to the Court of Wirtemberg, has offered a prize of 150 florins (13 guineas), for that explanation which shall be judged the most satisfactory on the subject of the fossil bones continually found in the kingdom of Wirtemberg. It is not simply a critical dissertation which is expected on the different opinions relative to the events which may have transported these remains of the animal kingdom into the places where they are now found; but it is most particularly desired that some elucidation should be given from the chemical decomposition and connection of these bones. It is desired also, that a deduction should be made of the characteristic

racteristic epochas of their existence from the geologic proportions of the successive or gradual strata in which they take their origin, in order to establish upon those data a better judgment than has heretofore been made concerning the revolutions our globe may have been subjected to with regard to the animal kingdom. It will therefore be necessary, for the accomplishment of this purpose, to endeavour to collect into determinate species the animal skeletons at present come to our knowledge, to shew the identity and the differences of these skeletons with respect to living animals; and lastly, to assign to the species, considered as extinct, the rank which they ought to hold in the natural history of the animals still existing on the face of the earth.

Planetary Epocha.

Planetary epocha of 280,000 years.

M. de Lalande received, in the month of April last, an anonymous letter, from Franckfort, in which it was said that a German of high reputation in several sciences discovered, fifty years ago, a remarkable period of 280,000 years for the return of the six planets to the same point of the heavens, and his opinion thereon is requested to be given in the Magazin Encyclopédique of M. Millin. The number of revolutions found by the German astronomer for each of the planets have been reduced into seconds by Lalande from the revolutions as at present known, and are as under:

Mercury....	1162577	8836135098921.
Venus.....	455122	8835595689448.
Earth	280000	8835940680000.
Mars	148878	8835946519500.
Jupiter	23616	8835946544448.
Saturn.....	9516	8835946558608.

M. Lalande remarks, that these numbers differ so little that the deviation from the same precise number of seconds in each sum of revolutions is not greater than the uncertainty in the known durations of those revolutions. He therefore considers the return of the planets in 280,000 years as a curious result, and is desirous of knowing the name of him who had the courage to make such long calculations.

Solar Spots.

Solar spots.

M. Hultz, a Prussian Astronomer, of Frankfort on the Oder, has published an opinion, in August last, that the sun at that time was undergoing a considerable change. His opinion was founded on a number of spots occupying one-fifth part of its diameter in their length and one-nineteenth in their breadth. These spots varied in their form, and were perceptibly changed in the course of two or three hours.

To Mr. Nicholson.

Sir,

I shall feel particularly obliged to some of your numerous correspondents for information, through the medium of the Journal, respecting the manner of dissolving the elastic gum (*Caoutchouc*) so as to render it applicable to form a coat on silk, &c. for surgical purposes.

I am, Sir,

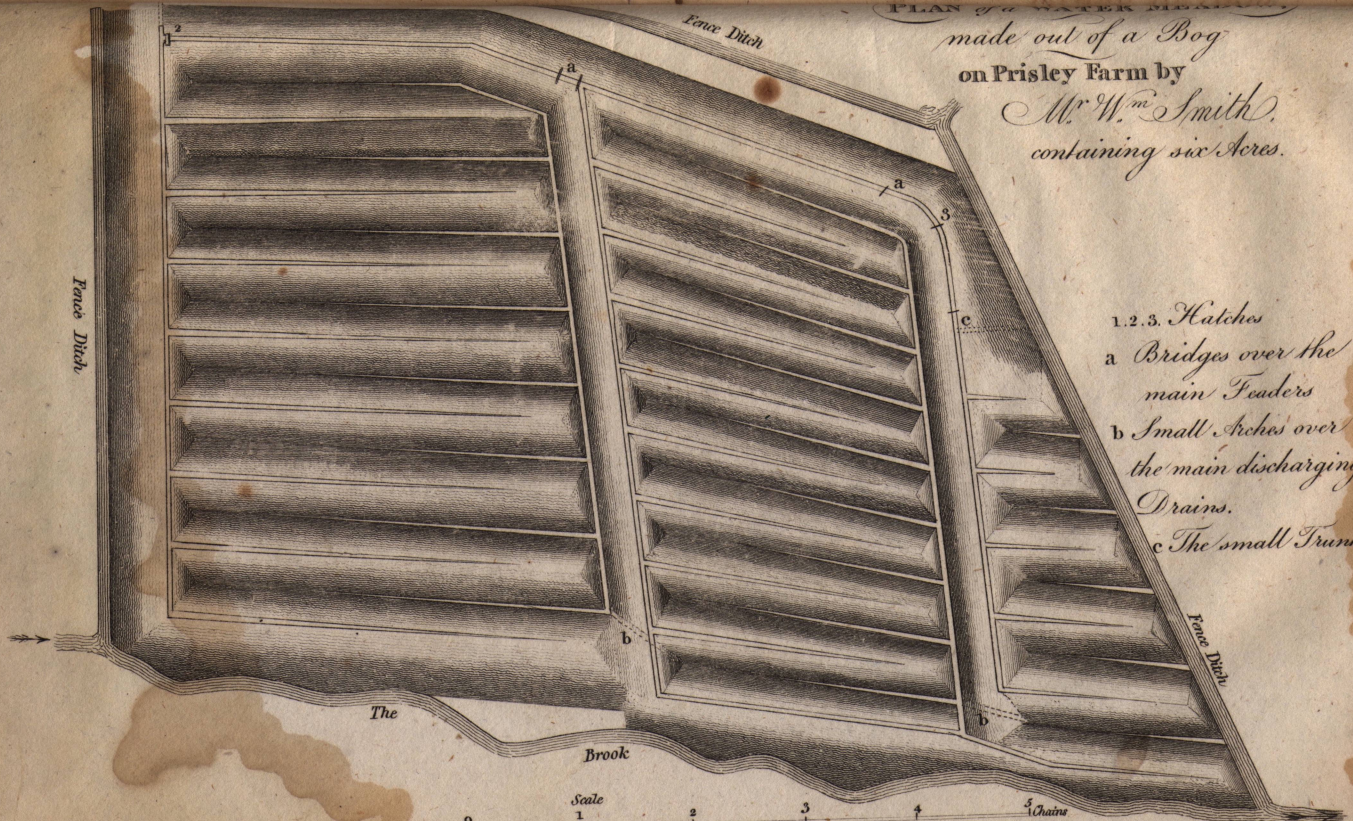
Your obedient servant,

Nov. 7, 1806. A CONSTANT READER.

RECORDS OF LITERATURE.

The prospectus of a new periodical work has just been circulated, entitled, Records of Literature; it is intended to present a general statement of the progress of knowledge in all its departments; and, by giving a brief account of all works announced or published, to form an Index to the Literature of the World.

I will examine the principal chemical laboratories, and if the subject should appear of sufficient novelty, after the general descriptions of Lewis, Macquer, Lavoisier, Brisou, and others, I will give a notice as requested by our correspondent X. Y.



Nicholson's Philos Journal Vol. IX Pl. 340.